

Introduction

This report summarizes the activities of the Physics Department in the year 2000. Most of our effort has been devoted to the development of research projects in Nuclear Physics, Condensed Matter, Astrophysics, Solar Energy and Applications of Analytical Techniques using the Heavy-Ion Accelerator TANDAR. Other related topics with strong involvement of our research staff include chaos and complex systems, intermediate energies, surface physics, diamond-like coatings and micro-electromechanical systems. All of these activities rely on the technical support provided by a number of auxiliary laboratories in the fields of electronics, high-vacuum, target and thin-foil production, mechanical workshop, and computers and networks.

As usual, during the reported period research work has been complemented with a strong involvement of our staff in teaching activities both as professors at local universities and within the framework of our postgraduate program. Nineteen graduate students have continued their PhD thesis work at our laboratories under the supervision of local researchers; four of these students have obtained their degrees during this year.

Despite the negative environment created by continued budgetary constraints as well as by the implementation of governmental programmes aimed at staff reduction via induced early-retirement, the overall scientific production and the accomplishment of important goals have been once again a distinctive characteristic of this period. A few among the most conspicuous facts in the different areas are the following:

Condensed Matter

- Synthesis and structural determination of two novel species of sulphur oxoanion complexes with unprecedented properties.
- Study of the coexistency between ferromagnetism and superconductivity.
- Theoretical prediction of new phases of fullerites with very low compressibilities (and thus, high hardness) through first-principle molecular dynamics calculations.
- The experimental control of the relative volume of antiferromagnetic and ferromagnetic phases in a manganese oxide, which shows the relation between giant magnetoresistance and phase coexistence.

TANDAR accelerator and applications

- The accelerator has operated during the year 2000 providing beams of ions in a relatively wide range of energies. It is particularly noticeable the lowest terminal voltage of 0.8 MV at which the machine was able to operate in a stable condition. The total beamtime available for experiments was of 5356 hours, a number substantially higher than those of the last few years.
- Among the applications, research on BNCT devoted an important effort to the optimisation of different nuclear reactions for neutron production. A simplified production-target prototype and the complete neutron-moderation device has been implemented. Other biological and biomedical applications include the production of external proton and lithium beams for the irradiation of biological material. A new experimental line was mounted and the radiological effects (RBE factors) were determined for several beams on normal and tumoral tissues.
- A new time-of-flight facility has been used for the first time for the detection and mass identification of the evaporation products in heavy-ion fusion reactions. This detection system is being optimised for the detection of ^{129}I in AMS measurements.

Solar Energy

Most of the activity of the group was related to the design of solar cells and panels in connection with the argentine space program. In this respect:

- Data analysis from the experimental cells mounted in the satellite mission SAC-A was completed. The overall performance was found to be very good and the electrical characteristics measured during the mission were found to be in very good agreement with the estimates based on previous laboratory measurements.
- A new probe to test mechanical fatigue in connectors for solar cells intended for space use has been developed and used.

Related to other applications, the Solar Energy group provided low-cost solarimeters for the National Weather Service (Servicio Meteorológico Nacional) which will be installed in portable weather stations located in remote areas of the country.

Astrophysics

The Physics Department has continued its strong involvement in the Pierre Auger Project, an international effort to make a detailed study of cosmic rays at the highest energies. A Memorandum of Understanding between the International Collaboration and Comisión Nacional de Energía Atómica (CNEA) describing the activities by the personnel of CNEA to the Pierre Auger Project and the contributions to the design and construction of the observatory has been signed.

The construction of the southern-hemisphere observatory located at Pampa Amarilla in the province of Mendoza has proceeded according to schedule. In particular the Central Station in the town of Malargue and the building of one telescope (out of a total of four) located in Cerro Los Leones have been almost completed.

The activities of our Physics Department has been supported mainly by our home institution, CNEA, although we must also acknowledge important contributions from other agencies such as the National Research Council (CONICET), the National Agency for Science and Technology (ANPCyT), and Fundación Antorchas.

For the first time this Progress Report is being published in its electronic version only. Unlike previous versions, it covers a shorter period (one year instead of two or three), which we hope will contribute to make it more valuable and more representative of our current interests and projects. I would like to thank M.E. Spina, G. Mastrogiacomo and R. De Luca who contributed with their hard work towards the implementation of these changes.

Alberto J. Pacheco

August 2000

Nuclear Physics

Nuclear Spectroscopy

The activities of the group include two sets of different problems. Both subjects utilize in general similar nuclear spectroscopy techniques and the same heavy ion beams produced by the TANDAR accelerator. The first set of problems corresponds to applied research (from the point of view of nuclear physics but not necessarily of the other disciplines) and tries to contribute in other areas generating interdisciplinary and partly technological activities. Applications to biomedical and environmental problems are being pursued. On this sector, we can distinguish three lines:

a) Trace element analysis; b) Development of a heavy ion microbeam; c) Feasibility studies on novel accelerator-based cancer therapy modalities.

The second set of problems is in the field of basic research on nuclear structure.

Trace Element Analysis

The most frequently employed techniques are PIXE and PIGE (Particle Induced X-ray (Gamma) Emission). The first one is a high-sensitivity multielement analysis technique based on the heavy ion excitation and detection of characteristic X-rays of the elements present in samples of diverse origin. In biomedicine, problems studied have been, among others, metabolic alterations in living species related to presence of Zn and multielement determination with emphasis on aluminium concentration in sinovial fluid samples. As far as environmental problems are concerned the PIXE technique has been applied to the determination of lead concentration and other polluting agents in atmospheric aerosols of Buenos Aires city and surroundings. Since our last survey, Pb concentration in Buenos Aires diminished by a factor of about 20 after the introduction of unleaded gasoline in Argentina, a behavior similar to that observed in other large cities around the world. The PIGE technique, which utilizes gamma-rays of nuclear origin induced by heavy ions, is an interesting alternative in the case of very light elements. We have applied it for the detection of boron traces in connection with BNCT (Boron Neutron Capture Theory).

Heavy ion microbeam

We aim at implementing at one of the beam lines of the TANDAR accelerator a facility which could be characterized as a nuclear microscope, i.e., a heavy ion microprobe. This microbeam in conjunction with nuclear and atomic techniques of excitation and detection like PIXE, PIGE, HIRBS (Heavy Ion Rutherford Backscattering), STIM (Scanning Transmission Ion Microscopy), etc., will allow the quantitative determination of the multielement composition, the modification of properties and structural characterization of different systems with a spatial resolution of the order of a micron. This microprobe and its associated beam line has been mechanically mounted on an antivibration base and will become operative in 2001.

Feasibility Studies related to Cancertherapy

- **Protontherapy**

The charged particle beams have definite advantages compared to other types of radiation (like gamma rays) for tumor treatment. In some cases, like eye melanoma, spectacular success has been achieved. This technique is known as protontherapy. There is interest to stimulate activity which may eventually lead to the introduction of this modality in our country. In this context external proton and Li beams have been produced at the TANDAR laboratory and a program to irradiate small animals and cell cultures was started in collaboration with radiobiology personnel. Relative Biological Effectiveness (RBE) associated with p and Li beams of different energies was determined for different tumor cell lines. In particular the Li beams aim at simulating the effects of the Li fragment being emitted in the BNCT reaction (see below).

- **Boron Neutron Capture Therapy (BNCT)**

With the proton or deuteron beams available at the TANDAR accelerator it is possible to generate a neutron flux that can be used to carry out feasibility studies related to a possible therapy by boron neutron capture, BNCT, based on the very high cross section of the capture reaction $^{10}\text{B}(n,\alpha)^7\text{Li}$. The

idea is to load selectively a tumor with boron and irradiate it with neutrons. The “microexplosion” associated to each reaction has a high lethality for cancer cells affecting only the immediately surrounding tissue. In the past BNCT has been based exclusively on nuclear reactors for research and treatment. There is however currently a strong tendency and important progress towards the development of accelerator-based neutron sources. There is a generalized perception that if BNCT is to become an option for cancer treatment it would be necessary to have accelerator-based neutron sources, not only due to their much lower cost and complexity but also because the implantation of a nuclear reactor in a hospital would not be acceptable given the public perception in relation with this type of facility. We have started to explore the neutron production via protons of relatively low energy (some MeV) on a lithium target. A LiF neutron production target has been built and neutron flux determinations have been performed both through the activation method and through the detection of the 478 keV gamma ray following the BNCT reaction. The latter method will serve to monitor on-line the dose delivered to a tumor. We have studied the $^{13}\text{C}(d,n)$ reaction as a candidate for accelerator-based BNCT through a collaborative project with scientists from the Laboratory for Accelerator Beam Applications at MIT. We have also started to explore the possibility of developing a low-energy (2 MeV), high-current (20 microA) proton accelerator for BNCT.

Basic research on nuclear structure

This program includes several high-spin nuclear structure topics of current interest. One is the study of coupling schemes of valence nucleons in deformed nuclei, in particular in doubly odd species, in which we have recently found connections to the identical band problem. Here our attention is focused on structures which included aligned pseudospins as means to produce twin bands (i.e. bands with very similar transition energies) in neighboring nuclei. During the course of these investigations a very interesting result was obtained, namely twin bands but with very different moments of inertia (“non-identical” twin bands). Also the problem of signature inversion has been the subject of several investigations. Finally, we mention the study of the octupole instability in the actinide region. The aim has been here to map out the reflection asymmetry degree of freedom to reach the predicted maximum in this deformation and to establish the limits for performance of in-beam spectroscopic studies in the presence of a very severe fission competition.

“Alternating parity bands in $^{218}\text{Fr}_{87}$ ”

M.E. Debray, M.A. Cardona, D. Hojman, A.J. Kreiner, M. Davidson, J. Davidson, H. Somacal, G. Levinton, D.R. Napoli, S. Lenzi, G. De Angelis, M. De Poli, A. Gadea, D. Bazzacco, C. Rossi-Alvarez and N. Medina

Phys. Rev. C62 (2000) 024304

States in doubly odd ^{218}Fr have been studied using in-beam spectroscopy α - γ - γ coincidence techniques mainly through the $^{209}\text{Bi}(^{18}\text{O}, 2\alpha n)$ reaction at 94 MeV bombarding energy, using the 8π GASP-ISIS spectrometer at Legnaro. ^{218}Fr 4 shows a band structure, with interleaved states of alternating parities connected by enhanced $E1$ transitions. Tentative spin assignment and the relation between the structure of ^{218}Fr and its isotope ^{220}Ac is discussed.

“Coupling modes in doubly odd nuclei: The case of ^{172}Ta ”

D. Hojman, M.A. Cardona, M. Davidson, M.E. Debray, A.J. Kreiner, F. Le Blanc, A. Burlón, J. Davidson, G. Levinton, H. Somacal, J.M. Keszue, F. Naab, M.J. Ozafrán, P. Stoliar, M. Vázquez, D.R. Napoli, D. Bazzacco, N. Blasi, S.M. Lenzi, G. Lo Bianco and C. Rossi-Alvarez

Phys. Rev. C61 (2000) 064322

High-spin states in doubly odd ^{172}Ta were investigated in two different experiments by means of in-beam γ -ray and internal-conversion electron spectroscopy techniques. Excited states of ^{172}Ta were populated using the $^{159}\text{Tb}(^{18}\text{O}, 5n)$ and $^{165}\text{Ho}(^{12}\text{C}, 5n)$ reactions at beam energies of 93 and 79 MeV, respectively. Eleven rotational bands, including twin bands in the normal deformation regime, have been observed and their configurations discussed. Three isomeric states have been found and their half-lives measured. Alignments, band crossing frequencies, and electromagnetic properties have been analyzed in the framework of the cranking model.

“Transition strengths in odd-odd ^{80}Rb ”

M.A. Cardona, G. García Bermúdez, R.A. Kaye,
G.Z. Solomon and S.L. Tabor

Phys. Rev. C61 (2000) 044316

Lifetimes of levels in ^{80}Rb have been measured using the Doppler shift attenuation method. The high-spin states have been populated through the $^{55}\text{Mn}(^{28}\text{Si}, 2pn)$ reaction at 90 MeV. Collective enhancement was observed in the $B(E2)$ values of the two most strongly populated bands, while the $B(M1)$ values of the yrast band exhibit a large alternating pattern. Transition quadrupole moments were deduced from $E2$ transition strengths and compared with those predicted by Woods-Saxon cranking calculations.

“Signature Inversion in Odd-Odd Nuclei Around $A=80$ ”

G. García Bermúdez, M.A. Cardona

Act. Phys. Hung., Heavy Ion Physics II (2000)
345

Signature inversion in odd-odd nuclei have been found systematically in regions of mass number $A=80, 130$ and 160 , and although several explanations have been proposed to interpret this phenomenon, it is still not well understood. The data of electromagnetic properties obtained through lifetime measurements, will be very useful to elucidate this phenomenon. In the present work, we review several lifetime studies that measured the $B(M1)$ strengths in the mass $A=80$ region. The results show that the alternating pattern in the $B(M1)$ strengths is preserved across the signature inversion region. Also is reviewed the critical angular momentum, frequency and moment of inertia at the signature inversion point for several mass regions. The correlations among these and other nuclear parameters are discussed.

“Acumulación de Zn en Ovarios de Sapo Bufo Arenarum. Efecto sobre el Metabolismo de Carbohidratos”

T.M. Fonovich de Schroeder, A.F. Preller,
F.U. Naab, M.E. Caraballo, A. Burlón,
M.A. Cardona, M. Debray, D. Hojman,
M.J. Ozafrán, M.E. Vázquez and A.M. Pechén de
D'Angelo

Brasilian Journal of Toxicology **13**, N° 1 (2000)
55

Females of the toad *Bufo arenarum* accumulate Zn when they are maintained in a cage besides the Reconquista river (province of Buenos Aires). Ovulation occurs normally when these animals are injected with homologous hypophysis, as compared to control ones. Oocytes from these females can not only be fertilized but also develop until they reach the gastrula stage. Significant inhibition (27 %) of embryonic development can be observed from the muscular response stage on. In vivo simultaneous microinjection with Zn and $[\text{U-}^{14}\text{C}]\text{Glucose}$ rendered a decrease in the incorporation of the label in glycogen as well as in CO_2 . Glucose-6-P dehydrogenase activity was inhibited in vitro by Zn at 1,53 mM, a concentration similar to the ones accumulated in the ovary and microinjected into the oocytes in the previous experiments. Our results are in agreement with an inhibitory effect of Zn on early developmental stages of the embryos, probably due to deficient production or NADPH, ribose-5-phosphate and ATP in the oocytes.

“In-phantom dosimetry using the $^{13}\text{C}(d,n)^{14}\text{N}$ reaction for BNCT.”

A. Burlon, A. J. Kreiner, S. White, J. C. Yanch, B.
Blackburn and D. Gierga.

*Proceedings of the XIX International Symposium
on Neutron Capture Therapy for Cancer, Osaka,
Japan, (2000) 53*

The use of the $^{13}\text{C}(d,n)^{14}\text{N}$ reaction at $E_d=1.5$ MeV for accelerator-based boron neutron capture therapy is investigated. Among the deuteron-induced reactions at low incident energy, the $^{13}\text{C}(d,n)^{14}\text{N}$ reaction is one of the best because of the advantages of carbon as a target material and its large cross section. The deuteron beam was produced by a tandem accelerator at MIT's Laboratory for Accelerator Beam Applications. The resulting neutron spectra were evaluated in terms of RBE-dose rates at different depths inside a water-filled brain phantom using a heavy water moderator and lead reflector assembly. Dosimetry results were obtained using the dual ionization chamber

technique for fast neutrons and photons and bare and cadmium-covered gold foils for the thermal neutron flux. The RBE-doses in tumor and healthy tissue were calculated from experimental data assuming a tumor ^{10}B concentration of 40 ppm and a healthy tissue ^{10}B concentration of 11 ppm. All

results were simulated using the code MCNP, a Monte Carlo neutron and photon transport code. A treatment time of 90 minutes was obtained for a tumor located at 5.7 cm depth within the brain, assuming a 20 RBE-Gy dose in a single beam session and a 4 mA deuteron current.

Heavy-Ion Physics And Accelerator Mass Spectrometry

This group focused its activities on the study of basic aspects of nuclear reaction mechanisms and on applied research in connection with the analytical technique known as accelerator mass spectrometry (AMS). Even though the subjects covered by these two lines are very different, they share similar instrumental and methodological requirements as far as the performance of the actual experiments is concerned.

The nuclear-reaction line consisted mainly of two main sub-projects:

- Search for chaotic behaviour in nuclear reactions: Theoretical studies predict that, under certain conditions, nuclear scattering might exhibit peculiar behavior associated with the quantum manifestation of chaotic phenomena. In order to clarify this point we have studied the $^{16}\text{O} + ^{28}\text{Si}$ system for which exhaustive calculations have been recently performed. The obtained experimental results have been compared with the theoretical two-dimensional patterns obtained for the elastic and inelastic cross sections as a function of the energy and the scattering angle for that system.
- Subcoulomb fusion barrier distributions: Fusion cross sections at energies close to or below the Coulomb barrier present behaviours which are related to various structural aspects of the nuclei involved in the collision. These features become particularly noticeable when the results are analysed in terms of the so called "barrier distributions". We are investigating several reaction systems with the aim of identifying the effect of the inelastic and transfer channels in the barrier distributions obtained from the measurement of quasi-elastic excitation functions at backward angles.

The other research line has a more applied character and it is related to the use of the Tandem particle accelerator as an extremely sensitive mass spectrometer for the determination of very low concentrations of long-lived radioisotopes. In this we intensively studied the production of radioisotopes in meteorites. We have also started preliminary work on the research of long-range environmental effects of human activity in the nuclear field. For that goal we propose to measure the concentration of the isotopes ^{129}I , ^{36}Cl , and ^{99}Tc in samples collected in the vicinity of nuclear power plants, covering the entire process starting with the ion production from the samples of interest up to the separation from different backgrounds and its final identification.

"A coupled-channel analysis of scattering, two-neutron transfer and fusion in medium heavy-ion collisions"

J.E. Testoni, O. Dragun, H Massmann and M.R. Spinella

Nuc. Phys. A669 (2000) 173

Scattering, two-neutron transfer and fusion processes are analyzed in the scope of a coupled-channel formalism using collective excitations in the real and a gauge space. A small set of collective states simplifies the calculation of formfactors allowing an easy evaluation of interesting physical quantities such as cross-sections, probability densities, currents, fusion rates, spin distributions and probability sources and sinks in the different channels. The availability of these quantities makes possible an insight that clarifies the underlying reaction mechanisms. In particular, a barrier, modified by the coupling between channels, is introduced, permitting an interpretation of relevant characteristics of the interaction processes. The system $^{18}\text{O} + ^{60}\text{Ni}$ is specifically studied at energies

of $E=63$ and $65\text{--}66\text{ MeV}$ for the scattering and two-neutron transfer, respectively, and at energies around the Coulomb barrier for fusion. In this case, it can be observed that the presence of the transfer channel plays a catalytic role in the enhancement of the fusion cross-section by incrementing the contribution of the dispersion channels.

"Barrier distribution for the $^{32}\text{S} + ^{110}\text{Pd}$ system derived from the quasielastic scattering excitation function"

O.A. Capurro, J.E. Testoni, D. Abriola, D.E. Di Gregorio, G.V. Martí, A.J. Pacheco and M.R. Spinella

Phys. Rev. C61 (2000) 037603

We measured the quasi-elastic scattering excitation function for the $^{32}\text{S} + ^{110}\text{Pd}$ system at a backward angle and at energies around the Coulomb barrier. A fine enough energy step was adopted in order to obtain a representation of the

barrier distribution through the first differentiation of the data. Our results were compared with the barrier distribution that was deduced from fusion data for the same system.

“Transfer Reactions with Vibrational Nuclei”

H.D. Marta, R. Donangelo, J.O. Fernández Niello and A.J. Pacheco

Phys. Rev. C61 (2000) 064610

A previously developed semiclassical model of transfer reactions is extended to the case in which one of the collision partners is a vibrational nucleus. In these systems a rapid transition from normal to anomalous slope at the Coulomb barrier is experimentally observed in the two proton stripping reactions. We demonstrate that this behaviour can be reproduced by the model.

“Quasi-elastic scattering measurements in the systems $^{12,13}\text{C} + ^{105,106}\text{Pd}$ ”

O.A. Capurro, J.E. Testoni, D. Abriola, E. Achterberg, D.E. DiGregorio, G.V. Martí, A.J. Pacheco, and M.R. Spinella

Acta Physica Hungarica, Heavy Ion Physics II (2000) 355

Quasi-elastic scattering excitation functions at backward angles and near barrier energies for the systems $^{12,13}\text{C} + ^{105,106}\text{Pd}$ have been measured. The first derivative of the cross sections respect to the energy was determined. The purpose of this work is to evaluate if such derivative is a good representation of the barrier distribution involved in the fusion process. The results are analyzed considering that the characteristics of the barrier distribution depends on the effective Q-values.

“The AMS Technique and Environmental Applications at the Tandem Laboratory”

G.V. Martí, J.O. Fernández Niello, R. Liberman, D. Alvarez, A. Arazi, D. Abriola, E. Achterberg, O. Capurro, M. di Tada, A.M.J. Ferrero, A.J. Pacheco, M. Ramírez and J.O. Testoni

Acta Physica Hungarica, Heavy Ion Physics II (2000) 473

The accelerator-mass-spectrometry (AMS) technique developed at the TANDAM laboratory in Buenos Aires is being mainly dedicated to environmental and astrophysical problems. For this

purpose, from the earliest stages the activities have been aimed to address the upgrading and optimization of different components of the accelerator. Taking into account that only an excellent performance of the ion source and of the accelerator itself will provide reliable conditions to apply this technique, we have emphasized our work on the following areas: a) ion source and sample preparations, b) general stability and beam transmission through the accelerator, and c) detection systems. In this work we report a summary of these activities and we describe the progress achieved along all these lines. Finally, we present and discuss the initial results of the application of AMS to the measurement of the latitudinal distribution of the long-lived radioisotope ^{36}Cl in rainwater samples, and to the study of ^{59}Ni in meteorite material.

“Search for chaotic behavior in nuclear scattering”

G.V. Martí, A.J. Pacheco, J.E. Testoni, D. Abriola, O.A. Capurro, D.E. DiGregorio, J.O. Fernández Niello, E. Achterberg, D.E. Álvarez and M.R. Spinella

Acta Physica Hungarica, Heavy Ion Physics II (2000) 269

Angular distributions for the elastic and inelastic scattering in the $^{16}\text{O} + ^{28}\text{Si}$ system have been measured in two energy regions, one close to the Coulomb barrier and the other well above. Fine steps in both bombarding energy (0.5-1.0 MeV) and scattering angle (0.8°) make it possible to compare the data with the theoretical calculations that predict, for each of these regions, distinctive cross-section patterns in correspondence with the classical occurrence of either regular or chaotic regimes. The experimental results show specific differences between the two explored energy ranges in qualitative agreement with the theoretical predictions.

“Barrier Distributions Derived from Quasielastic Excitation Functions for the $^{12,13}\text{C} + ^{105,106}\text{Pd}$ Systems”

O.A. Capurro, J.E. Testoni, D. Abriola, D.E. Di Gregorio, G.V. Martí, A.J. Pacheco, M.R. Spinella and E. Achterberg

Phys. Rev. C62 (2000) 014613

Quasielastic excitation functions for the $^{12,13}\text{C} + ^{105,106}\text{Pd}$ systems were measured at near barrier energies. The representations of the fusion barrier

distributions derived from the measured cross sections were analyzed by comparison with simplified coupled-channel calculations. The influence of transfer reaction channels can be distinguished from that due to the inelastic excitation. The influence of two-phonon state on the barrier distributions was evaluated.

“Pigüem Nonraltá o Campo del Cielo. Meteoritos en el Monte Chaqueño”

*J.O. Fernández Niello and R.G. Liberman
Ciencia Hoy 10, N° 59 (2000) 18*

Incansables viajeros del sistema solar encuentran, a veces, reposo en nuestra Tierra. Estos cuerpos, que llamamos meteoritos, adquieren un interés científico cada vez mayor a medida que se perfeccionan las técnicas de investigación destinadas a develar la preciosa información en ellos contenida. Más allá de este interés, tan propio de nuestro tiempo, se llega a sentir, ante ellos, un asombro reverente, tal vez no demasiado distante de aquel que pudo llevar a su sacralización en épocas remotas.

“The AMS system and research program at the TANDAR Laboratory”

J.O. Fernández Niello, R.G. Liberman, O.A. Capurro, A.M.J. Ferrero, G.V. Martí, A.J. Pacheco, D. Abriola, M. Ramírez, J.E. Testoni, E. Achterberg, D.E. Alvarez and M. di Tada

Nuclear Instruments and Methods in Physical Research B172 (2000) 91

Several aspects of the AMS program at the TANDAR laboratory are discussed. The current activities are focused on environmental and cosmological applications. One of the projects has been the study of the global fallout of the radioisotope ^{36}Cl and its latitudinal distribution in the southern hemisphere. We have also undertaken some of the preparatory work to measure the concentration of several radioisotopes in extraterrestrial samples obtained from a meteorite fall in northern Argentina. An important fraction of our effort in pursuing these studies has been the optimization of the technique in our 20UD tandem. We discuss the results of recent tests carried out to evaluate the current capabilities of the accelerator regarding general stability, predictability, and transmission efficiency, following the upgrading and adaptation activities.

“Evaluación de Secciones Eficaces de Fusión a Energías Próximas a la Barrera Coulombiana utilizando un Formalismo de Canales Acoplados”

J.E. Testoni, O. Dragun, M.R. Spinella and H. Massman

Anales AFA 10 (2000) 47

A coupled-channel formalism is presented which allows to calculate, simultaneously, cross sections corresponding to elastic, inelastic, transfer of two neutrons and fusion. The nuclear excitations are considered as rotations in the real space and the two-neutron transfer as a rotation in a gauge space. The target as well as the projectile are considered to have zero spin. For different reaction channels the formalism permits to obtain wave functions, angular distributions of differential cross sections, total cross sections, excitation functions and spin distributions.

“Angular momentum in the $^6\text{He}+^{209}\text{Bi}$ reaction deduced from isomer ratio measurements”

P.A. DeYoung, B. Atallah, B. Hughey, P.L. Jolivet, M. Kern, G.F. Peaslee, V. Guimaraes, J.J. Kolata, D. Peterson, P. Santi, R. White-Stevens, E.F. Aguilera, E. Martinez-Quiroz, F.D. Bechetti, M.Y. Lee, J.A. Zimmerman, J.D. Hinnefeld and O.A. Capurro

Phys. Rev. C62 (2000) 047601

The angular momentum distribution of the compound nucleus is a fundamental characteristic of the reaction dynamics and can provide insight into reactions involving neutron- or proton-rich projectiles. Specifically, following the fusion of ^6He with ^{209}Bi (at center-of-mass energies of 18 to 27 MeV), ^{212}At is formed by the evaporation of three neutrons from the compound nucleus. The decay process leaves the residual ^{212}At in either the ground state ($J^\pi = 1^-, T_{1/2} = 314$ ms) or a metastable state ($J^\pi = 9^-, T_{1/2} = 119$ ms). The ratio of the number of residual ^{212m}At to the total number of ^{212}At residual nuclei is sensitive to the original momentum distribution of the compound nucleus. The measured isomer ratio is consistent with that predicted by standard models. This agreement is observed even at the lower energies where the measured three neutron evaporation cross section is greatly enhanced compared to model calculations. While the inclusion of coupling to the neutron-transfer channels improves the agreement with the observed cross-section data somewhat, the predicted isomer ratio then diverges from the measured ratio

Astrophysics

Pierre Auger Project

TANDAR GROUP: A. Etchegoyen, P. Bauleo, C. Bonifazi, A. Boselli, N. Fazzini, A. Filevich, H. González, and S. Nigro

The Pierre Auger Project aims at studying a foremost issue in astrophysics today, the origin of the most energetic cosmic rays with energies in excess of 10^{19} eV, focusing our attention in energies above 10^{20} eV. The flux of these latter cosmic rays is roughly estimated to be $1/\text{km}^2/\text{century}/\text{sr}$ and due to this, an International Collaboration spanning institutions in 19 countries has met to build two similar observatories $3,000 \text{ km}^2$ each, one in the southern hemisphere (in Malargüe, Province of Mendoza, Argentina) and one in the northern hemisphere (in Utah, USA).

Two experimental techniques will be used: surface detectors and fluorescence telescopes. Such hybrid approach will diminish systematic errors and will allow to measure both lateral and longitudinal shower profiles, respectively. The construction of the southern observatory has begun, and we are currently assembling an Engineering Array consisting in 38 surface detectors, two fluorescence telescopes, telecommunications and Central Station buildings. After finishing this phase, we plan to begin full construction next year.

The Argentinean Collaboration have groups working at Tandara/CNEA, the University of La Plata, the Institute Balseiro/CNEA-UNC, the Technological University at Mendoza, and to a lesser extend in the Instituto de Astronomía y Física del Espacio/CONICET, and Malargüe and San Rafael/CNEA. We are involved in most aspects of the project.

The overall cost of the Pierre Auger Southern Observatory is \$ 50,000,000 out of which CNEA will contribute, provided the availability of Federal Funds, with \$ 10,000,000 and the Province of Mendoza with \$ 5,000,000. This budget is earmarked towards construction of the Observatory, apart of which we will need to train young scientists and technicians to profit of this unique basic science project in this country. The overall management and responsibility of Argentina's expenditures is performed by Dr. A. Etchegoyen as Principal Investigator with accountability to the financing institutions and the International Collaboration. Eng. H. González is in charge of the accounting of CNEA's budget expenditures. The Project at CNEA depends from the Science and Technology Program, headed by Dra. Ma. C. Cambiaggio.

The Central Station Buildings

There are two main buildings in the Central Station, the Assembly and Office-Control building and a telecommunication tower, the three built under the supervision of Eng. N. Fazzini.

The Assembly Building was built with Mendoza's funding and it is already operational. As a distinct feature it has an ultra pure water plant technically specified and purchased by Dr. A. Filevich. The storage tank and water transportation systems were also designed and procured at Tandar. We are currently involved in the deployment of the surface detectors.

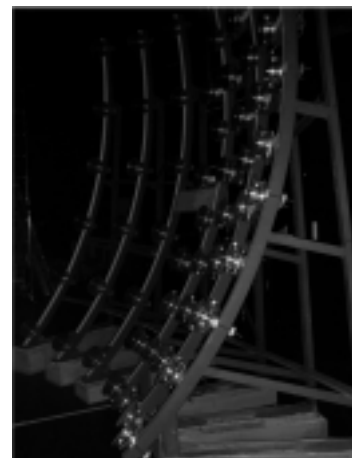
The Office Building is being budget with an additional funding of \$ 1M from the University of Chicago.



In the above pictures is displayed the Assembly Building, with the INTERNET satellite dish, the telecommunication tower and the 50,000 l ultra-pure water storage tank. On the right hand side is seen the construction of the Office Building.

Los Leones Building

The Observatory will have four fluorescence detector sites, the first one has already been built with funds from Mendoza and under the supervision of Eng. N. Fazzini. The original layout was performed by Dr. A. Filevich.



Above it is displayed the Los Leones building plus the telecommunication tower. The building has six bays for six telescopes, each one spanning 30 degrees in azimuth and elevation. Two prototypes are being assembled by the German and Italian collaborations and should be complete in May 2001. The German support structure is displayed on the right hand side.

The Surface Detectors

The surface detectors are ultra-pure water tanks which will measure Cherenkov light produced by the incoming shower particles. There will 1,600 of them regularly spread, 1,500 km apart from each, other over the 3,000 km². The first tank was deployed in Feb/2000.



In the above picture is displayed the first deployed tank.

The Tandar group centers its work on the surface detectors. Argentina is in charge of all tank deployment and the construction of 500 of them. We will manufacture all the internal highly diffuse reflective liners, the analog front end, the telecommunication antennae, the solar panels supports, batteries and batteries enclosures. The manufacturing of tanks and batteries enclosures is under the responsibility of Dr. A. Boselli and of the solar panels support of Eng. S. Nigro.



Above is displayed the water deployment of tank # 16, a difficult deployment position. The water transportation tank is installed on a flat bed and it is being pulled by two caterpillars.

On the right is seen a detail of the solar panel, communication antenna and electronics box of a tank.

Education and Outreach

The gift from the University of Chicago includes funds for a visitor's center. The visitor's center on the Auger Central Campus in Malargüe will augment an already strong outreach program with the people of the region. On each occasion of the recent collaboration meetings talks were organized for the community and the schools. At the 12-17 November collaboration meeting we invited the Malargüe community to an open house for the new Assembly Building. All of these events were enthusiastically received and well attended by the community. In turn, the mayor of Malargüe invited Auger collaborators to attend celebrations associated with 50th anniversary of the city. This included the Auger group participating in a parade down the main street. We were very warmly received.

Summary

The Pierre Auger Project is unique in magnitude for a basic science project in the history Argentina since it encompasses 19 nations, 50 institutions, 250 scientists/engineers and an Observatory site in this country over an area of 3,000 km². It entails the logistics of an expeditious free-customs duties for foreign equipment and the commissioning of the detectors. We are now just at the beginning of a great scientific adventure. The excitement is that we really do not know what we will find. But whatever it is, it will reveal news physics or astrophysics.

Apart from Tandar, we count on the paramount contributions from the other Argentinean groups already mentioned.

Argentina has the enormous responsibility of hosting the Southern Observatory. Apart of complying with our commitments to the International Collaboration we will need to train young scientists to be able to benefit from this 20-year long Project. These scientists will have the opportunity to work on a stimulating international environment and stay in this country.

Structural coatings, Surfaces studies and ionic implantation

The properties of the surface of different substrates are modified by means of two techniques: the first one is ion implantation with energies ranging between 100 to 400 keV and the second one is coating of a surface with a hard amorphous carbon film or a related material. The aim of the ion implantation techniques is to modify the properties or the crystalline structure of the surface of different materials. The purpose of the second one is to grow hard films using different ion beams, to protect the surface from the wear caused by abrasion or chemical attack. The principal protective coatings so far produced and studied are: hard amorphous carbon films (a:C) of about 1 μ m thickness, N containing a:C films and amorphous carbon rich SiC films. The main idea is to establish a correlation between physics-chemical and tribological properties of these films. It is particularly relevant to determine which composition and microscopic structure give the compound greater thermal stability, hardness and/or wear resistance.

The physical properties of these films and of the modified substrate are evaluated by various methods: Raman spectroscopy to study the amorphous character of the films, XPS and EELS for structural and compositional studies, heavy ion beam techniques (HIRBS and ERDA) to determine the concentration of different elements in the film and on the treated surface and positron annihilations spectroscopy (PAS) to estimate the size of clusters forming the amorphous matrix. Tribological properties are studied measuring indentation hardness, elastic modulus, wear resistance and scratch damage.

During the last years, several developments have been performed using a heavy ion beam in the analysis of material (ERDA and HIRBS techniques), in particular, in the determination of the concentration profile of elements in the zone near of the surface of the material (around one micron).

At present our main objective is to reduce the difficulties connected with the ERDA technique, for example the gas handling system of our detector, the data analysis and the complicated experimental setup in general. To fulfill this we planned different tasks such as: improving the gaseous detector, developing a new data acquisition systems based on a standard personal computer (PC) and using a particular software for data analysis, and finally the installing a dedicated scattering chamber. In summary, the principal purpose is to develop a reliable experimental setup, which could be used by different groups without major difficulties to get high quality analytical results as fast as possible.

Condensed Matter

The staff consists of 21 professionals and 2 technicians, plus a variable number of undergraduate and graduate students (at present: 20)

Projects on the move, all of them on solid state physics or condensed matter in general, include a variety of topics and techniques, with an important thematic inbreeding linking them. A brief description of the intervening Groups and Laboratories follows.

Laboratory Of Chemical Synthesis And Characterization:

A variety of perovskitic materials are obtained and characterized, in particular substituted manganese oxides. Among other materials of interest we find copper and alkaline earth metals, anhydrous formates, mixed copper and transition metals hydrated formates, and other related compounds of biological or technological interest. In this area some hydroxyapatites as well as their cationic and anionic substitution derivatives are also studied.

X-Ray Diffraction:

Areas of interest are: molecular structures of new coordination compounds with transition metals and polymorphs with a pharmacological interest, structural phase transitions and the study of compounds with modulated structures. Present interest is centered in the study of manganese oxides structure by Rietveld refinement. The Laboratory runs a facility for the identification of third party crystalline samples by x-ray powder diffractometry.

Raman Spectroscopy:

Systematic studies are performed on thin films of amorphous carbon (diamond like) over different substrates, in order to fully characterize them.

Mössbauer Spectroscopy:

^{57}Fe Mössbauer spectroscopy is at present applied to the study of: nanoparticles -mainly nanohematites-, the mineralogy of argentine soils and Zr-containing alloys. Some works of corrosion of steels were also performed.

Electrical Properties:

Measurements of dielectric constants, electrical conductivity and alternate magnetic susceptibility are performed on ceramics and single crystals, as a function of temperature (30-300 K), in the presence of a magnetic field of up to 1 Tesla. Presently, the interest is centered on the study of manganese oxides with magnetoresistent properties.

Condensed Matter Theory:

The different lines include: calculations of electronic structures and magnetic properties of different metallic systems of low dimensionality through 'ab-initio' methods (LMTO-FLAPW). Calculation of transport properties on disordered systems and metallic superlattices. Dynamical properties of molecular crystals, using molecular dynamics. Static and dynamic properties of incommensurate phases. Molecular dynamics applied to C60-like molecules. Montecarlo calculations to obtain the phase diagram and dielectric constant of dipolar molecular liquids and antiferromagnetic systems with defects. Extended dynamical systems with self-criticality, complex systems, game theory. Study of the liquid-solid transition, from the point of view of a broken translation symmetry in a liquid. Order-disorder phase transitions in periodic systems with competing interactions. Structural and dynamical properties of C and Si compounds using semiempirical potentials.

“On the Metallic Behavior of Co Clusters”

*F.Aguilera-Granja, J.M. Montejano-Carrizales,
J.Guevara and A.M.Llois*

Solid State Comm. 113 (2000) 147

The role of structure in the nonmetal-metal transition of Co clusters is investigated by performing calculations for different symmetries : hexahedral, octahedral and decahedral. This transition occurs when the density of states at the Fermi level exceeds $1/kT$ and the discrete energy levels begin to form a quasi-continuous band. The electronic structure is calculated including spd orbitals and spillover effects in a Hubbard Hamiltonian solved within the unrestricted Hartree-Fock approximation. We find that in small clusters ($N < 40$) the metallic behavior is strongly related to the geometrical structure of the cluster. We compare our results with those coming out of a simple Friedel's model.

“Calculation of the Magnetoresistance of YMn_2Ge_2 and $LaMn_2Ge_2$ ”

J. Milano and A.M. Llois

Physica Status Solidi B220 (2000) 409

We have calculated the diffusive conductivity and ballistic conductance of the layered compounds YMn_2Ge_2 and $LaMn_2Ge_2$. For YMn_2Ge_2 we obtain a negative band contribution to the giant magnetoresistance. For $LaMn_2Ge_2$ we show that the band contribution can already explain the experimentally observed large positive magnetoresistance if a nearly ferromagnetic structure is considered.

“Electronic Properties of small free Co-clusters”

*F. Aguilera Granja, J.M. Montejano Carrizales,
J.A. Guevara and A.M. Llois*

Physica Status Solidi B220 (2000) 455

We present a systematic study of the average magnetic moments and the non-metal-metal transitions of free Co_N clusters having different geometries: hexahedral, octahedral and decahedral. The electronic structure is calculated with a parameterized Hubbard Hamiltonian with spd electrons within the unrestricted Hartree-Fock approximation, and spill-over effects are considered. We compare our calculations with other theoretical calculations in the literature. We also comment on the experimental results.

“Linear defects on Cu(111): The appearance and disappearance of surface states”

M.A. Barral and A.M. Llois

Phys. Rev. B62 (2000) 12668

The appearance and disappearance of the Schockley surface state at Cu(111) is studied as a function of density and width of extended adsorbed defects using a Hamiltonian which contains s, p and d orbitals in the basis. The local electronic density of the surface state at the Γ point is obtained atom by atom. We also report on 1D and 2D defect states lying near the Fermi level.

“Study of Ce Intermetallic Compounds: A Local-Density Approximation, Classification and Hybridization Effects”

V. Vildosola and A.M. Llois

Phys. Rev. B62 (2000) 7027

Spin-polarized calculations within the local-density approximation have been made with the goal of characterizing Ce intermetallic compounds. Effects of symmetry and chemical environment on 4f hybridization and, thereafter, on magnetization have been studied.

“New Superhard Phases for Three-Dimensional C60-based Fullerites”

E. Burgos, E. Halac, R. Weht, H. Bonadeo, E. Artacho and P.Ordejon

Physical Review Letters 85 (2000) 2328

We have explored new possible phases of 3D C60-based fullerites using semiempirical potentials and ab-initio density functional methods. We have found three closely related structures - two body centered orthorhombic and one body centered cubic - having 52, 56 and 60 tetracoordinated atoms per molecule. These 3D polymers result in semiconductors with bulk moduli near 300 GPa, and shear moduli around 240 GPa, which make them good candidates for new low density superhard materials.

“On the Crystal Structure of C₃₆”

E. Burgos, E. Halac, H. Bonadeo

Chem. Phys. Lett. 320 (2000) 14

We present calculations which indicate that the newly synthesized C₃₆ molecule probably forms a Van der Waals crystal, of rhombohedral or hexagonal structure. Our results, based on intermolecular potentials of the atom-atom form, are in good agreement with the existing experimental evidence. Using covalent semiempirical potentials, we find that if molecules are placed closely together they tend to form extra bonds, several energy minima are thus obtained, but these correspond to structures with either too large or too short intermolecular distances in the basal plane.

“Electronic Structure of the Superconducting Layered Ternary Nitrides CaTaN₂ and CaNbN₂”

J.M. Oliva, R. Weht, P. Ordejon and E. Canadell

Phys. Rev. B62 (2000) 1512

The electronic structure of the layered ternary nitrides CaMN₂ (M=Ta, Nb) has been studied and the results are compared with those for the related LiMoN₂ phase. It is shown that the former are two-dimensional metals, with a Fermi surface very similar to that of the 1T-TaX₂ (X = S, Se) dichalcogenides, whereas the latter is a three-dimensional metal. The three phases show strong covalent bonding within the layers but ionic bonding with the alkali atom sheets.

“Electronic Fine Structure on the Electron-Hole Plasma in SrB₆”

C.O. Rodriguez, R. Weht and W.E. Pickett

Physical Review Letters 84 (2000) 3903

Fine structure arising from the mixing between overlapping electron and hole bands in alkaline earth hexaborides such as SrB₆ leads to lower energy (temperature) scales than occurs in their doped counterparts (viz. Sr_{0.995}La_{0.005}B₆), which are high critical temperature, tiny moment ferromagnets. Two of the calculated Fermi surface extremal orbits agree well with two of the three observed miniscule cross sections, and optical absorption and transport behavior are consistent with calculated energy scale. These results suggest that SrB₆ is a conventional Fermi liquid at the temperature of the de Haas -- van Alphen measurements, but the drop in resistivity at 0.5 K likely indicates a phase transition to a more conductive phase.

“Self-organization in a minority game: the role of memory and a probabilistic approach”

E. Burgos and H. Ceva.

Physica A 284 (2000) 489

A minority game whose strategies are given by probabilities p , is replaced by a ‘simplified’ version that makes no use of memories at all. Numerical results show that the corresponding distribution functions are indistinguishable. A related approach, using as random walk formulation, allows us to identify the origin of correlations and self

organization in the model, and to understand their disappearance for a different strategy's update rules, as pointed out in a previous work.

“The ordered and orientationally disordered crystalline phases of the flexible C₄F₈ molecule”

Z. Gamba and B. M. Powell

J. Chem. Phys. **112** (2000) 3787

There is ample experimental evidence for the existence of several crystalline phases of C₄F₈, although they still have been not clearly identified. In this paper we report a series of molecular dynamics (MD) simulations using a partially flexible molecular model, which takes into account the mixing of the low frequency intramolecular modes and lattice modes. The calculations are carried out at constant pressure and constant temperature and the algorithm employed allows for volume and symmetry changes of the (MD) sample as a function of thermodynamic variables. Although several stable crystalline phases are found, their number is still less than determined by experiments.

“Test of a simple and flexible molecule model for α -, β - and γ -S₈ crystals”

C. Pastorino and Z. Gamba

J. Chem. Phys. **112** (2000) 282

S₈ is the most stable compound of elemental sulfur in solid and liquid phases, at ambient pressure and below 400K. Three crystalline phases of S₈ have been clearly identified in this range of thermodynamic parameters, although no calculation of its phase diagram has been performed yet. α - and γ -S₈ are orientationally ordered crystals while β -S₈ is measured as orientationally disordered. In this paper we analyze the phase diagram of S₈ crystals, as given by a simple and flexible molecule model, via a series of molecular dynamics (MD) simulations. The calculations are performed in the constant pressure- constant temperature ensemble, using an algorithm that is able to reproduce structural phase transitions.

“Test of a simple and flexible S₈ model molecule in α -S₈ crystals”

C. Pastorino and Z. Gamba

Chem. Phys. Lett. **319**, 20 (2000).

α -S₈ is the most stable crystalline form, at ambient pressure and temperature (STP), of elemental sulfur. In this paper we analyze the zero pressure low temperature part of the phase diagram of this crystal, in order to test a simple and flexible model molecule. The calculations consist in a series of molecular dynamics (MD) simulations, performed in the constant pressure- constant temperature ensemble. Our calculations show that this model, that gives good results for three crystalline phases at STP and T._>300K, fails at low temperatures, predicting a structural phase transition at 200K where there could be none.

“Study of sulfur α -S₈ crystals with an anisotropic intermolecular potential model”

C. Pastorino and Z. Gamba

Chem. Phys. **261**, 317 (2000)

An anisotropic atom-atom intermolecular potential model is used to study the α - S₈ phase of this elemental sulfur compound. Comparisons with the results obtained in previous papers, using an isotropic model are performed. The possible existence of a monoclinic α' -S₈ polymorph is discussed.

“Density fluctuations and entropy”

J.A. Hernando and L. Blum,

Phys. Rev. E **62**, 6577 (2000)

A new functional for the entropy that is asymptotically correct both in the high and low density limits is proposed. The new form is

$$S = S^{(id)} + S^{(ln)} + S^{(r)} + S^{(c)}$$

where the new term $S^{(c)}$ depends on the p-bodies density fluctuations α_p and renormalizes the ring approximation $S^{(r)}$. This result is obtained by analyzing the functional dependence of the most general expression of the entropy: Two main results for $S^{(c)}$ are proven: i) In the thermodynamic limit it is only a functional of the one body distribution function and ii) by summing to infinite order the leading contributions in the density a new numerical expression for the entropy with a new renormalized ring approximation is obtained. The relation of

these results to the incompressible approximation for the entropy is discussed and preliminary numerical results on hard spheres are presented.

“Structural and transport properties of La_{0.67}Sr_{0.33}Mn(1-x)Sn_xO₃ thin films”

S. Duhalde, M. Villafuerte, M.C. Tezzoli, G. Polla, A.G. Leyva, L. Correr

Applied Physics A69 (7) (2000) 65

The magnetotransport properties of perovskite manganite films have attracted much recent interest because of the colossal magnetoresistance exhibited (CMR). The La_{1-x}Sr_xMnO₃ mixed valence compound contains Mn³⁺ with the configuration t_{2g}³ e_g¹ and Mn⁴⁺ ions with a t_{2g}³ structure. The doping with Sn could play a role regarding the structural and magnetotransport properties as the tin ions does not share the same interaction as the manganese ions. We report in this work the structural and transport characteristics of as-deposited and post-deposition annealed La_{0.67}Sr_{0.33}Mn_{1-x}Sn_xO₃ thin films by pulsed laser deposition (PLD). We analyzed the influence of the tin doping on films properties. X-ray diffraction (XRD), scanning electron microscopy (SEM) and R vs. T measurements were performed. We found that tin doping promotes oxygenation of the films, increasing the temperature of electrical transition T_c, and could be an alternative to post-annealing treatments.

“Pathological Mineralizations: Calcifications and Si-bearing particles in soft tissues and their eventual relationship to different prostheses”

A.G. Leyva, S.L. Maghid, M.A. Rodríguez de Benyacar, M.A. Lazaro, J. Maldonado Cocco and G. Citera

Artificial Organs 24 (3) (2000) 179

Polarizing microscopy (PM), scanning electron microscopy (SEM), x-ray dispersive analysis (EDAX), x-ray diffraction (XRD), and infrared spectrometry (IR) were used to study the following pathological mineralizations: calcifications and silicon (Si)-bearing particles in cerebral tissue from an epileptic child; traces of Si-bearing particles in periprosthetic mammarian tissue, and calcifications in capsular mammarian tissue from a patient with a silicone gel mammarian implant, and 2 calcium-bearing compounds, atypical apatitic calcification, and a nonphosphorous-bearing calcification in

arterial tissues. In this tissue we also found Si-bearing particles due to an artifact from glassware.

“The monoclinic/orthorhombic phase transition in Ba₂Cu(HCOO)₆: an optical and X-ray powder diffraction study”

G. Polla, D. Vega, A.G. Leyva, P.K. de Perazzo, H. Lanza, M.A.R.de Benyacar

Phase Transitions, Vol. 72 (2000) 15

α -Ba₂Cu(HCOO)₆ grown at room temperature crystallizes in space group P2₁. On heating a reversible, hysteretic, equitranslational, first-order phase transition at about 60-90 °C takes place. Here we discuss the influence of thermal treatments on the occurrence, coexistence and stability ranges of the observed phases, as studied by several techniques (optical microscopy, differential scanning calorimetry and X-ray diffraction). On cooling a single set of domain walls parallel to (001) have been observed. Taking into account experimental results and the crystal pseudosymmetry of the α phase we propose that the high-temperature β phase crystallizes in space group Pbnm.

“Vibrational spectra of Ba₂Cu(HCOO)₆ crystals”

A. Ayala, J. Henriques Nieto, C. Paschoal, I. Guedes, J.M. Sasaki, P. Freire, F. Melo, J. Mendes Filho, A.G. Leyva, G. Polla, D. Vega, P. Perazzo

J.Raman Spectroscopy 31 (6) (2000) 491

Polarized Raman spectra of single crystals of barium copper formate at room temperature were recorded and analyzed. The spectra were obtained for geometries allowing the observation of A (TO) and B (TO and LO) species. The assignment of the fundamental modes was performed on the basis of formate group vibrations and correlations with previous data reported for other formate crystals. The observation of four separate wavenumbers for all internal modes of formate ion is indicative of four crystallographically non-equivalent formate ions in the unit cell.

“Controlled Phase Separation in La_{0.5}Ca_{0.5}MnO₃”

P. Levy, F. Parisi, G. Polla, D. Vega, G. Leyva, H. Lanza, R.S. Freitas and L. Ghivelder

Phys. Rev. B62 (2000) 6437

The ground state of the half doped manganite La_{0.5}Ca_{0.5}MnO₃ has a complex behavior, in which an antiferromagnetic charge ordered (AFM-CO) phase and a ferromagnetic (FM) phase can coexist. A systematic study of phase separation effects in polycrystalline La_{0.5}Ca_{0.5}MnO₃ under different thermal treatments is reported. Samples with average grain size ranging from 200 to 1300 nm were studied. Magnetic and electrical measurements show quantitative differences among samples in their low temperature behavior, indicating that the fraction of the FM phase gradually decreases as the grain size increases. Percolation of the FM phase in samples with even a small fraction of this phase suggests that grain boundaries play a distinctive role in the spatial distribution of coexisting phases. The defective structure at the grain surface could explain the local inhibition of the AFMCO phase, an effect that is gradually removed by grain size increase. Qualitative agreement of the data with this description is found. Besides, this effect is also found to be highly dependent on the oxygen content and its spatial distribution.

“Speciation of As(III) and As(V) in aqueous solutions using baker's yeast and hydride generation inductively coupled plasma atomic emission spectrometric determination”

P. Smichowski, J. Marrero, A. Ledesma, G. Polla and D. Batistoni.

Journal of Analytical Atomic Spectrometry (JAAS) 15 (2000) 1493

In this study, the use of *Saccharomyces cerevisiae* was evaluated as substrate for the biosorption of As(III) in the presence of As(V) from aqueous solutions. Experiments were performed in batch as a suitable and simple method to obtain information of arsenic uptake by yeast cells. The effect of chemical and physical variables affecting the biosorption of As were evaluated in order to select the optimal analytical conditions for the selective As retention by *Saccharomyces cerevisiae*. The parameters studied were: reaction media, pH, amount of biomass, analyte concentration and contact time. The influence of some concomitant ions up to 50 mg l⁻¹ was also tested. Quantitative determinations of As species in yeast and

supernatant were carried out by means of inductively coupled plasma atomic emission spectrometry with hydride generation. During all the steps of the optimisation process, As(V) remained in solution while As(III) was accumulated by the yeast cells. The speciation of inorganic As species in different kinds of natural waters was performed following the method proposed. Spiked water samples were also prepared and the recoveries in each phase were in all cases between 91 and 105%.

“Temperature dependent Raman study of CaCu(HCOO)₄ and Ca₂Cu(HCOO)₆ crystals”

C.W.A.Paschoal, M.R. Moura, A.P.Ayala, J.M.Sasaki, P.T.C.Freire, F.E.A.Melo, J.Mendes Fille, I. Guedes, A.G.leyva, G.Polla, D.Vega and P.K. Perazzo

J.Solid State Chem. 8791 (2000) 338

Unpolarized Raman spectra of polycrystalline samples of calcium(II) copper(II) formate and dicalcium(II)copper(II)formate were recorded and analyzed in the temperature range from 30 to 300K. The observed modes at 300K were assigned on the basis of formate group vibrations and correlations with previous data reported for other formate compounds. The splitting of the internal HCOO modes agrees with the group theory predictions. No changes either in the wavenumber or intensity of Raman modes were observed when the temperature of the samples was cooled to 30K. This indicates that these compounds do not exhibit any phase transformation in the temperature range investigated.

“1-2-(Dimethylamino)-1-(4-methoxyphenyl) ethylcyclohexanol hydrochloride (Venlafaxine Hydrochloride)”

D. Vega, D. Fernández, G. Echeverría

Acta Cryst. C56 (2000) 1009

The crystal structure of racemic Venlafaxine hydrochloride (C₁₇H₂₈NO₂⁺, Cl⁻) consists of two types of parallel chains formed by translated Venlafaxine+cations, H-bonded by Cl⁻ anions, and characterized by the opposite chirality of their constituent molecules. These chains organize in two different types of broad layers of opposite handedness, related by a glide plane.

“Bis[chlorobis(1,10-phenanthroline-N,N’)](thiourea-S)nickel(II)Chloride Nitrate Diethanol solvate”

L. Suescun, A.W. Mombrú, R. A. Mariezcurrena, H. Pardo, S. Russi and R. Baggio

Acta Cryst. C56 (2000) 179

$C_{27}H_{26}Cl_{11.5}N_{6.5}NiO_{2.5}S$ crystallizes in the polar space group *Fdd2* with 16 formulas per unit cell. The crystal structure is formed by cations of $[Ni(phen)_2(thiourea)Cl]^+$, chloride and nitrate counter ions and ethanol solvate molecules. The nickel atom is octahedrally coordinated to two bidentate phen, a monodentate thiourea and to a chlorine ion. Both the chloride and nitrate anions, which provide to the charge balance, are placed at special positions in a two fold symmetry axis. Hydrogen bonds play a key role in packing and conformation of the cation, determining a three-dimensional network.

“Triaqua-tris(m-oxodiacetato)di-praseodimium(iii) Pentahydrate and Hexaqua-tris(m-oxodiacetato) di-neodimium(iii) Dihydrate,oxodiacetic acid solvate”

R. Baggio, M.T. Garland, M. Perec

Acta Cryst. C56 (2000) 312

Two new complexes of the $Ln_2(oda)_3.nH_2O$ series are reported: $[Pr_2(C_4H_4O_5)_3(H_2O)_3.5H_2O]_n$ and $Nd_2(C_4H_4O_5)_3(H_2O)_6.2H_2O.C_4H_6O_5]_n$. The former is isostructural to the reported La compound while the latter is a new structural variety within the series. Each compound exhibits two independent, nine coordinated Ln centers showing a variety of coordination geometries.

“Tris(2,2’-Bipyridyl)-nickel(ii) thiosulfate, heptahydrate”

E. Freire, S. Baggio, A. Mombru, R. Baggio

Acta Cryst. C56 (2000) 541

The structure of the title compound ($C_{30}H_{38}N_6NiO_{10}S_2$) consists of monomeric $Ni(bipy)_3^{2+}$ cations embedded into an anionic network made up of $S_2O_3^{2-}$ ions and hydration water molecules. The structure presents the unusual feature of two neighbouring thiosulfates approaching linearly head to head to an unusually short S...S contact of 3.25 Å.

“Novel Europium and Gadolinium Compounds in the Lanthanide(III) Oxydiacetate Series”

P.F. Aramendia, R. Baggio, M.T. Garland, M. Perec

Inorg.Chim.Acta 303/2 (2000) 306

The preparation and characterization of the europium(III) and gadolinium(III) oxydiacetate compounds $\{[Ln_2(oda)_3(H_2O)_2].5H_2O\}_n$ are described. The crystallographic data reveal a novel structural modification within the lanthanide oxydiacetate series. Also, the first species of a lanthanide(III) containing oda and Hoda simultaneously, $[Eu(oda)(Hoda)(H_2O)].2H_2O$, is reported.

“Three New Zn(II) Sulfate Complexes”

M. Harvey, S. Baggio, A. Mombro and R.F. Baggio
Acta Cryst. C56 (2000) 771

The three zinc sulfate complexes presented herein display three completely different coordination modes, viz.: $Zn(C_{12}H_8N_2)(SO_4)(H_2O)_3 \cdot (H_2O)$ (octahedral, monomeric); $(Zn_2(C_{14}H_{12}N_2)_2(SO_4)_2)$ (tetrahedral, dimeric) and $[Zn(C_{10}H_8N_2)(SO_4)(H_2O)_2]_n$ (octahedral, polymeric). In the former, the sulfate acts as monodentate while in the other two as a bidentate bridge between two different Zn centers. There is a variety of sulfate S-O bond lengths, depending on the different coordination conditions and H-bonding interactions.

“Synthesis, structure and magnetic properties of the oxydiacetato-bridged Cu(II)-Ln(III) complexes $[\{ Cu_3Ln_2(oda)_6(H_2O)_6 \} \cdot 12H_2O]_n$ (Ln = Y, Gd, Eu, Nd, Pr)”

R. Baggio, M.T. Garland, O. Peña, M. Pereg and E. Spodine

J. Chem. Soc., Dalton Trans., 2000, 13 (2000) 2061

Heterometallic compounds involving the rare earth(III) yttrium, gadolinium, europium, neodymium or praseodymium and copper(II) metal ions with oxydiacetate as the connecting ligand, have been investigated. Five isostructural polymers $[\{ Cu_3Ln_2(oda)_6(H_2O)_6 \} \cdot 12H_2O]_n$ (Ln = Y (1), Gd (2), Eu (3), Nd (4) and Pr (5)) have been obtained and structurally characterized. The Ln atoms in 1 to 5 show tricapped trigonal prism arrangements whereas the Cu atoms show octahedral geometry. The O(ether) atom of the oda ligand is bound exclusively to the Ln centers. Antiferromagnetic exchange interactions dominate in these compounds.

“Catena-poly [[diaqua(phenanthroline-N,N')cadmium(II)- μ -(sulfato-O:O')]] and Catena-poly [[diaqua (2,9-dimethylphenanthroline-N,N')cadmium(II)- μ -(sulfato-O:O')]]”

M. Harvey, S. Baggio, L. Suescun, R. Baggio
Acta Cryst. C56 (2000) 811

Both title compounds $C_{12}H_{12}CdN_2O_6S$ and $C_{14}H_{16}CdN_2O_6S$ are polymeric, and present the

cadmium atoms in very similar octahedral environments, provided by the bidentate organic ligand (phenanthroline/dimethylphenanthroline), two aqua molecules and two oxygens from two translationally related sulfate groups, which thus act as links of the resulting polymeric chains.

“Coordination mode of some polypyridyl ligands towards the platinum(II) complexes $[Pt(dppf)(H_2O)_2](CF_3SO_3)_2$ (dppf = 1,1'-bis(diphenylphosphino)-ferrocene) and $[Pt(Me_2SO)_2Cl_2]$. Crystal structure of the seven-membered chelate ring complex $[Pt(dpq)Cl_2]$ (dpq = 2,3-di(2-pyridyl)-quinoxaline)”

J. Granifo, M.E. Vargas, M.T. Garland, R. Baggio
Inorg. Chim. Acta 305 (2) (2000) 143

Crystals of the title compound are composed of discrete Pt-dpq- C_{12} units, connected through some π - π interactions as well as by hydrogen bonding. The molecular geometry is quite similar to the methylated Pd(II) analog (Cusumano, *Acta Cryst C54, 485-487*, 1998), as are some of the intermolecular interactions present, in spite of the compounds not being isostructural.

“Bis-(2,10-phenanthroline-N,N')-(thiosulfato-O,S)-nickel(II), hydrate, methanol solvate and Bis-(2,2'-bipyridyl-N,N')-(thiosulfato-O,S)-nickel(II), hydrate, methanol solvate”

E. Freire, S. Baggio, R. Mariezcurrena, R. Baggio
Acta Cryst. C56 (2000) 926

The compounds reported, $C_{20}H_{16}N_4NiO_3S_2 \cdot nH_2O \cdot mCH_3OH$ and $C_{24}H_{16}N_4NiO_3S_2 \cdot nH_2O \cdot m'CH_3OH$ are monomeric, with the nickel(II) ion displaying a distorted octahedral coordination provided by the four nitrogen atoms of two bidentate bipy (phen) groups and one sulfur and one oxygen from a chelate thiosulfate anion. The structures are highly unstable outside their mother liquors, and are stabilized in solution by a not fully determined number of water and methanol solvate molecules. The phenanthroline complex presents two independent moieties related by a non-crystallographic pseudo symmetry center. The thiosulfate anions present the usual S-O lengthening found when the anion acts in a bidentate mode.

**“Aqua-bis(crotonato)-bis-(pyridine)
copper(II)”**

R. Baggio, B. Foxman, M.T. Garland, M. Perec
and W. Shang

Acta Cryst. C56 (2000) e505

The title compound, $\text{Cu}(\text{O}_2\text{CCH}=\text{CHCH}_3)_2(\text{py})_2(\text{H}_2\text{O})$, crystallizes as a monomer, with the copper ion in a pentacoordinated square pyramidal environment, bisected by a twofold axis through the cation and the apex. The molecules organize in chains connected by H-bonds running along the unique axis b.

**“X-ray study on the nickel(II)-oxydiacetic
system and its 1,10-phenanthroline and
2,2': 6', 2'' terpyridine adducts”**

R. Baggio, M.T. Garland, M. Perec

Inorg.Chim.Acta, 310 (2000) 81

Three new metal-organic coordination complexes have been prepared and their crystal structures determined: $[\text{Ni}(\text{oda})(\text{H}_2\text{O})_3] \cdot 1.5\text{H}_2\text{O}$, $[\text{Ni}(\text{oda})(\text{phen})(\text{H}_2\text{O})] \cdot 1.5\text{H}_2\text{O}$ and $[\text{Ni}(\text{oda})(\text{terpy})] \cdot 2\text{H}_2\text{O}$ (oda = oxydiacetate, phen = 1,10-phenanthroline, terpy = 2,2': 6', 2'' terpyridine). The oxydiacetate ligand is tridentate in these compounds, being nearly planar in the first two and hinged in the latter. Hydrogen-bonding and p-p interaction is extensive in the three solids.

**“X-ray study of two novel nickel(II)-
thiosulfate compounds”**

E. Freire, S. Baggio, L. Suescun and R. Baggio

Australian Journal of Chem. 532 (9) (2000) 785

Two novel nickel thiosulfate complexes have been prepared and their crystal structures determined: $\text{NiS}_2\text{O}_3(\text{dmph})(\text{H}_2\text{O}) \cdot \text{H}_2\text{O} \cdot \text{CH}_3\text{OH}$ (i) (dmph = 2,9-dimethyl-1,10-phenanthroline), which to our knowledge is the first pentacoordinated nickel thiosulfate complex described so far, and $\text{NiS}_2\text{O}_3(\text{dmph})$ (ii), an hexacoordinated complex which displays a thiosulfate binding mode with no precedents in the literature, viz.: bridging solely through oxygen. Compound (i) is monoclinic, $C2/c$, a 26.269(5), b 7.641(3), c 18.381(3) Å, β 97.00(2)°, V 3662(2) Å³, $Z=8$, conventional R (on F) being 0.049 for 2217 No observed reflexions ($I > 2\sigma(I)$). Compound (ii) is also monoclinic, $P21/n$, a 11.108(2), b 10.955(2), c 11.666(2) Å, β

103.32(3)°, V 1381.4(5) Å³, $z=4$, R 0.036, No 2497.

**“Molecular Structure and Magnetic
Properties of
[Gd(LH₄)(NO₃)₂(H₂O)]NO₃(H₂O)₂,
[Sm(LH₄)(NO₃)₂(H₂O)]NO₃(H₂O)_{1.5}(CH₃OH)_{0.5}
and [Cu₂(LH₂)(H₂O)₂](NO₃)₂ Complexes
(LH₄: Schiff base ligand derived from 4-
methyl-2, 6-diformylphenol and 1,3-
diaminopropanol)”**

E. Spodine, Y. Moreno, M.T. Garland, O. Pena and
R.F. Baggio

Inorganica Chimica Acta 309 (2000) 57

Novel lanthanide(III) complexes (Ln = Gd (1), Sm (2), La (3)) of the macrocyclic ligand LH₄ have been prepared and characterized. The binuclear copper(II) complex $(\text{Cu}_2(\text{LH}_2)(\text{H}_2\text{O})(\text{NO}_3)_2)$ (4), has been obtained by transmetalation of complex 3 with $\text{Cu}(\text{CF}_3\text{COO})_2$. The macrocyclic Schiff base ligand (LH₄) is formed by the condensation of two molecules of 4-methyl-2, 6-diformylphenol with two molecules of 1,3-diaminopropanol in the presence of the lanthanide ions. The alcohol group of the macrocycle does not coordinate to the copper(II) centers of the binuclear complex. However, one of the secondary alcohol groups of the ligand coordinates in an asymmetric mode to the lanthanide ion in the corresponding three complexes. The X-ray crystal structures of $(\text{Gd}(\text{LH}_4)(\text{NO}_3)_2(\text{H}_2\text{O}))(\text{NO}_3)(\text{H}_2\text{O})_2$ (1), $(\text{Sm}(\text{LH}_4)(\text{NO}_3)_2(\text{H}_2\text{O}))(\text{NO}_3)(\text{H}_2\text{O})_{1.5}(\text{CH}_3\text{OH})_{0.5}$ (2), and $(\text{Cu}_2(\text{LH}_2)(\text{H}_2\text{O})_2)(\text{NO}_3)_2$ (4) have been determined. Magnetic susceptibility measurements in the 5-300 K range were obtained for these complexes.

**“Iron Oxide Mineralogy of a Mollisol from
Bahía Blanca by Selective Dissolution
Techniques, X-Ray Diffraction and
Mössbauer Spectroscopy”**

S.G. Acebal, A. Mijovilovich, E.H. Rueda, M.E.
Aguirre and C. Saragovi

Clays and Clay Min. 48 (3) (2000) 322

Selective dissolution techniques by ammonium oxalate (OX), dithionite-citrate-bicarbonate (DCB), and dithionite-ethylenediaminetetraacetic acid (D-EDTA), X-ray diffraction and Mössbauer

spectroscopy were used to identify and characterize iron oxides and oxyhydroxides in the <2-mm, <50- μm , and <2- μm size fractions of a Mollisol from Bahía Blanca, Argentina. Iron compounds are present at low concentrations in mixtures with quartz, Na-rich feldspar, illite, interstratified illite-montmorillonite, and traces of kaolinite. Total Fe and Al content increases as soil particle-size decreases, from 4.3 and 13.3 wt. % in the <2-mm size fraction to 8.5 and 22.8 wt. % in the clay fraction (<2 μm), respectively. No more than 25-30 % of the total Fe is associated with crystalline and amorphous Fe oxides. Weakly ferromagnetic hematite and goethite were identified in the different fractions. These phases have small particle sizes and/or low crystallinity, and/or Al-substituted sites. Crystalline magnetite or maghemite is scarce. These Fe phases are probably coating coarser particles. In all fractions, the efficiency for Fe removal is highest for the D-EDTA treatment and least efficient for the OX method, regardless of fraction size. The opposite is true for Al removal. Poorly crystallized oxalate-soluble hematite and goethite are only present in coarser fractions. Poorly crystallized and crystalline DCB and D-EDTA-soluble hematite and goethite are present in coarser fractions, but do not exist in the clay fraction. DCB treatment probably dissolves Al in the 2:1 type minerals occurring in this soil, whereas D-EDTA dissolves Fe in hydroxy interlayers or silicate phases.

“Characterization of corrosion layers of low alloy carbon steels in aqueous CO_2 (g) and brine solutions by transmission Mössbauer Spectroscopy”

E. Chung, C. Saragovi, I. Raspini

Corrosion NACE, 56 (8) (2000) 769

Transmission Mössbauer Spectroscopy (TMS), which is a powerful tool for atmospheric and marine corrosion studies, is presented here as a tool for characterising corrosion products formed in aqueous $\text{CO}_{2(\text{g})}$ saturated brines. An electrochemical process was applied to simulate a corrosion process at the bottom of an oil well (turbulence and aggressive environment) to obtain corrosion products. Their formation depends on composition of steels and environmental conditions. The characterisation through TMS of corrosion film formed on two low alloy carbon steels, one without Cr and another with 1% Cr, exposed to $\text{CO}_{2(\text{g})}$ flushed solutions has shown morphological and qualitative differences between the corrosion films. Ferrous carbonate (FeCO_3 , siderite), a faulted cementite (Fe_3C^*), and a particular carbide (Fe-C^*), both of the latter not reported before, were found in the corrosion products. The so-called Fe_3C^* is a cementite with two forms: an alloyed cementite as $(\text{Fe},\text{M})_3\text{C}$ ($\text{M}=\text{Mn}, \text{Cr}$) and/or as $\text{Fe}_{3-x}\text{C}_{1+x}$, a cementite with more carbon atoms as interstitials. The Fe-C^* carbide is possibly a small particle Fe-C phase with also two possible forms. Fe_3C^* and little of Fe-C^* carbides were identified on the probes without chromium. FeCO_3 and Fe-C carbide were identified on the probes with 1% Cr, being FeCO_3 the more adhesive constituent firmly linked to the base metal. It is suggested that the alloying elements in the steel (Cr in this case) other than Fe^{2+} ion concentration and neutralising agents are responsible for the formation of FeCO_3 . The better performance of the 1% Cr containing steel can be related to the presence of a protecting film formed by a mixture of both Fe-C^* carbide and FeCO_3 .

Solar Energy

The Solar Energy Group (GES) performs research and development activities related with photovoltaic solar energy conversion. Main tasks are design, simulation, fabrication and characterization of crystalline silicon devices (solar cells and modules) for space and terrestrial applications. During 1997, solar cells based on monocrystalline Czochralski silicon with 17% conversion efficiency were obtained.

The development of solar devices for space applications begun by the end of 1995, within the frame of a cooperation agreement between this National Atomic Energy Commission (CNEA) and the National Commission of Space Activities (CONAE). Activities in this field include: test of solar devices in Argentine satellites, radiation damage experiments in Earth and development of characterization techniques. The main goal in the mean-range is to set up fabrication techniques for space solar modules, in order to supply in the future the power requirements (totally or partially) of missions programmed in the National Space Plan.

On December 14th 1998, the Endeavour space shuttle launched the argentine satellite SAC-A at 410 km height. This satellite included the first experiment of Argentine silicon solar cells in space.

Several theoretical and experimental studies of radiation damage produced by 10 MeV protons are also being performed by means of a linear tandem accelerator and a cyclotron. Moreover, appropriate electrical and electronic characterization techniques and equipment have been developed.

In collaboration with the LAMEL Institute of the CNR (Italy), research activities related with simulation, elaboration and characterization of a-Si/c-Si and $\mu\text{c-Si/c-Si}$ heterojunction (HJ) solar cells as well as homojunction c-Si devices were performed. Thin film deposition techniques have been used. The test of these devices by means of radiation damage experiments will be performed in a near future in order to evaluate its behavior in space environment.

For terrestrial applications, the GES promotes and participates in the establishment of national standards for solar energy systems in the frame of the Argentine Institute for Standards (IRAM). Between 1997 and 2000, 13 standards for photovoltaic modules were established.

The GES begun the development of low cost solar radiation sensors (pyranometers) based on photovoltaic cells. Some prototypes were tested and calibrated by the National Meteorological Service and two of them are being used in meteorological stations in the provinces of Chaco and Corrientes.

Research activities related with the deposition and characterization of thin films (InP, CdTe, YBaCuO) for solar cells, gas sensors and superconductors, are also performed in collaboration with LAMEL Institute. In particular, the GES has participated in the installation in Argentina of a Laser Ablation Deposition (PLD) system for thin film growing in collaboration with the Physics Department-Facultad de Ingeniería, Universidad de Buenos Aires.

Since 1998, the GES participates in the development of SnO₂ thin film micromachined solid state gas sensors in collaboration with LAMEL Institute of the CNR (Italy) and with CITEFA (Argentina). A NO₂ selective gas sensor in the ppm range has been developed and is being tested in an electronic nose developed by the group in collaboration with INQUIMAE (Facultad de Ciencias Exactas y Naturales-Universidad de Buenos Aires) and with the School of Science and Technology (Universidad Nacional de General San Martín). Since 2000, a strategic agreement was signed with an Italian e-nose producer, Technobiochip S.R.L., for developing specific algorithms using its commercial apparatus (LibraNose) for local industry applications.

“Short circuit current vs. cell thickness in solar cells under rear illumination: a direct evaluation of the diffusion length”

J.C.Plá, M.J.L. Tamasi, C.G. Bolzi, G.L. Venier and J.C. Durán

Solid State Electronics 44/4 (2000) 719

The dependence of the short circuit current of a solar cell with its thickness is analysed for rear illumination. Under certain conditions, a simple linear regression in a semilogarithm scale is found. Using these results, an almost direct evaluation of the minority carrier diffusion length in the base region of crystalline silicon solar cells is achieved. For the other hand, from the experimental point of view, monochromatic light is not required and the equipment requirements are minimised. The model presented in this paper is theoretically evaluated using a 1-dimensional simulation code. Some preliminary experimental results are also shown.

“Determinación de parámetros característicos de celdas solares en el espacio a partir de mediciones recibidas por telemetría”

E.M.Godfrin, M.G. Martínez Bogado, M.J.L. Tamasi and J.C. Durán

Avances en Energías Renovables y Medio Ambiente 4 (I) (2000) 04-23

El satélite argentino SAC-A fue puesto en órbita en diciembre de 1998 y su misión se extendió durante aproximadamente 10 meses. Este satélite llevó al espacio un conjunto de 18 celdas solares de silicio fabricadas en la CNEA. Se analizó el funcionamiento de dichas celdas mediante las mediciones eléctricas recibidas por telemetría entre enero y julio de 1999. Se estudió la variación de la tensión de circuito abierto (V_{ca}) con la temperatura (0-70°C) y con la intensidad de la radiación solar incidente. Esta última varía debido a la presencia del albedo. Se calculó el coeficiente de temperatura para V_{ca} . A partir de la variación de V_{ca} con la intensidad, se realizaron estimaciones de parámetros del circuito equivalente de las celdas. La evolución temporal de los parámetros medidos no permite detectar degradación durante la misión. Los resultados obtenidos se comparan con mediciones en Tierra y con simulaciones teóricas.

“Influencia de la difusión de aluminio y fósforo sobre la vida media de portadores minoritarios en obleas de silicio cristalino”

M.G. Martínez Bogado, M.J.L. Tamasi, J.C. Plá, C.G. Bolzi and J.C. Durán

Avances en Energías Renovables y Medio Ambiente 4 (I) (2000) 04-17

Los procesos de difusión de dopantes utilizados en la elaboración de dispositivos fotovoltaicos de Si cristalino pueden promover mecanismos de atrapamiento de impurezas. Entre las técnicas habituales se destacan la difusión de P, como dopante tipo n, a partir de fuente líquida de $POCl_3$, y de Al como dopante tipo p. A fin de estudiar la captura de impurezas asociada a estas técnicas, se realizaron difusiones simultáneas de P y Al, y de P solamente, para obtener estructuras $n^{+}pp^{+}$ y $n^{+}p$, respectivamente. Empleando una variante del método de decaimiento de la tensión a circuito abierto (OCVD), se midió la vida media efectiva de los portadores minoritarios en diferentes etapas del proceso para evaluar el mecanismo de atrapamiento y sus consecuencias sobre las características eléctricas de las celdas solares. Se presentan asimismo simulaciones teóricas relacionadas con la influencia de la recombinación superficial en la cara posterior sobre la vida media efectiva.

“SAC-A satellite: first experiment of Argentine solar cells in space”

C.G. Bolzi, C.J. Bruno, J.C. Durán, E.M. Godfrin, M.G. Martínez Bogado, L.M. Merino, J.C. Plá, M.J.L. Tamasi and M. Barrera

Proc. 28th IEEE PVSC, Alaska, USA (2000) 1344

On December 1998, the Endeavour space shuttle launched the Argentine satellite SAC-A. Among several technological experiments, this satellite included a set of crystalline silicon solar cells fabricated in Argentina to test them in the space environment. In this paper, we describe the experiments associated with these solar cells and analyze the corresponding telemetry data received from January to July 1999. Simultaneously, several radiation damage experiments using 10 MeV protons supplied by a cyclotron accelerator were performed. The variation of the electrical characteristics of the irradiated cells are also presented.

“Low Temperature Fabrication Process for μ c-Si / c-Si Heterojunction Solar Cells”

J. Plá, E. Centurioni, R. Pinghini, C. Summonte, R. Rizzoli, F. Zignani, A. Desalvo

Proceedings of the 16th European Photovoltaic Solar Energy Conference(Glasgow, Scotland) (2000) 597

The optimisation of the fabrication process of μ c-Si/c-Si heterojunction solar cells is discussed, in order to obtain high efficiency / low cost devices. The deposition of the various layers of the device, having p^+i-n-n^+ structure, is carried out by Plasma Enhanced Chemical Vapour Deposition (PECVD) at Very High Frequency (VHF), with a process temperature as low as 170°C. An hydrogen plasma treatment is also used as alternative to the intrinsic layer for interface passivation. The front contact is obtained by a transparent conducting Indium Tin Oxide (ITO) layer, deposited by RF sputtering at 250°C, with an Al grid on top of it. This grid and the Al back contact are thermally evaporated. Particular attention was put in determining and minimising the contribution of each interface to series resistance. As an example, low temperature processing prevents from applying the standard metal alloying procedures used in silicon based microelectronics for contact fabrication. An alternative low temperature process for the rear contact formation is used, which gives a contact resistance lower than 0.03 ohm.cm². We studied each single interface, including the junction, by electrical characterisation. In this way, the interfaces affecting the series resistance can be identified and improved, and the technology needed for the production of μ c-Si/c-Si heterojunction solar cells can be accurately designed. Details of each process step and results obtained are discussed. An efficiency in excess of 13% was measured on test cells.

“Plasma Deposition of Amorphous Free Microcrystalline Silicon Films Thinner than 20 nm”

R. Rizzoli, C. Summonte, J. Plá, E. Centurioni, R. Pinghini, A. Desalvo and F. Zignani

Proceedings of the 16th European Photovoltaic Solar Energy Conference (Glasgow, Scotland) (2000) 593

Highly crystallised, thin p-type silicon films are deposited by very high frequency plasma-enhanced CVD. Under high H₂ dilution conditions, the effect of chamber contamination is shown to have consequences on the microcrystalline (μ c) fraction and electrical characteristics of the deposited films. In view of applications on heterojunction solar cells, p/i double layers are deposited on silicon and on glass. Optical characterisation shows that the μ c fraction is much larger on silicon substrate. A 15 nm amorphous buffer layer deposited on silicon is observed to completely recrystallise upon p-type μ c-Si deposition, which is attributed to the effect of undetectable crystalline seeds in the amorphous phase.

“Primera Experiencia de Celdas Solares Argentinas en el Espacio: Elaboración, Caracterización y Análisis de Datos de Telemetría del Satélite SAC-A”

C.G. Bolzi, C.J. Bruno, E.M. Godfrin, M.G. Martínez Bogado, L.M. Merino, J.C. Plá, M.J.L. Tamasi, J.C. Durán

Energías Renovables y Medio Ambiente 8 (2000) 1

El 14 de diciembre de 1998 el Transbordador Espacial “Endeavour” puso en órbita el satélite argentino SAC-A desarrollado por la Comisión Nacional de Actividades Espaciales (CONAE). Entre otras experiencias, la carga del SAC-A incluyó un conjunto de celdas solares de silicio monocristalino fabricadas en la CNEA. Este primer experimento de celdas solares argentinas en el espacio se encuadra dentro de un acuerdo de colaboración entre ambas instituciones cuyo objetivo principal es la puesta a punto en el país de la tecnología de fabricación de paneles solares para usos espaciales. Se describen los procesos utilizados en la elaboración de los dispositivos, su caracterización y los ensayos realizados en Tierra. Asimismo, se analiza el funcionamiento de las celdas solares en el ambiente espacial a partir de las mediciones eléctricas recibidas por telemetría entre enero y julio de 1999. Los resultados obtenidos se comparan con mediciones en Tierra.

“Identification of Pollutant Gases and its Concentrations with a Multisensorial Arrangement”

S. Reich, R.M. Negri, A. Lamagna and L. Dori

Proc. 7th International Symposium Olfaction and Electronic Noses, Ed. J.W. Gardner and KC Persaud, Institute of Physics, UK,(2000) 159

Multisensor arrays constituted by non-specific sensors, like in the case of electronic noses, is an appropriated approach to identify the presence of a particular gas in a mixture. While the dependence of the sensors signal output by the concentration of each single gas can be determined through a sensor calibration procedures., it is much more difficult (and of non- practical use in most of the cases) to know the response of the individual sensors when exposed to mixtures containing several components. In a previous work, Bartlett and Gardner have used a phenomenological linear model to simulate the response of semiconductor sensors to such a mixture. The concentration dependence of a sensor signal in a gas mixture of N components of concentrations $\{C_1, \dots, C_N\}$ was calculated as a linear combination of the sensors response to every individual gas in an artificial and well controlled atmosphere.

The aim of this work is to analyze the capability of an electronic nose model to identify gases, mainly CO and NO₂, normally present in polluted atmospheres. It is relevant also to identify organic reducing gases like isobutane (ISBU) which is emitted in a variety of different industrial processes. To reach the objective it is not a simple task because the output of each individual sensor is non-specific, but conditioned by the presence of the different gases. For example it is well known that

tin dioxide (SnO₂) sensors are particularly sensitive to alcohol's, mainly ethanol (EtOH). Other gases, although not pollutants, such as methane (CH₄), are present in the atmosphere and its concentration can drastically increase due to emissions from gas lines or natural fermentation processes.

For these reasons we have implemented a theoretical electronic nose model, composed by a few number of commercial tin dioxide sensors (Taguchi), addressed to identify the presence of CO, ISBU, CH₄ and EtOH and to determine their concentration. In this case the gas concentration ranges between few hundred to thousand parts per millions, which is the characteristic for Taguchi sensors. The concentration dependence of the sensors signal output to the single gas was taken from available Figaros Inc. sensor data sheets. Efforts have been made not only to identify the individual gas in humidified synthetic air, but to obtain the gas concentration of each individual compound, C_i, when the gases are contemporary present in a mixture of a given total analytical concentration. The linear response dependence assumed by Bartlett and Gardner was generalized using non-linear interpolation functions.

In a second part of the work, the electronic nose model was simulated using the experimental output of 100 nm thick SnO₂ sensors deposited upon a substrate heater element realized upon micromachined silicon substrate having 200 nm Si₃N₄ membrane as physical support of the entire sensor stack and developed by the LAMEL Institute, Bologna. The sensitivity towards several reducing and oxidizing gases is in the range of small fraction of ppm. This sensitivity level makes them suitable for environmental monitoring of pollutant gases such as CO, NO₂, benzene, and a mixture of toluene and xylene (TX).

Theoretical Physics

The activities of the group include several different items that are developed below.

Nuclear structure and nuclear reactions in low energies

New developments in radioactive beam acceleration and large detector arrays have allowed, not only the study of new nuclear systems, but also a much better knowledge of some spectroscopic observables. Hence, there are new possibilities to develop and test many body techniques applying in some cases previously developed solutions to new systems.

- Since the nuclear stability line departs from $N \gg Z$ for $A > 40$, previous detailed spectroscopic studies of those type of nuclei had been performed in lighter systems. This can be and is being studied using shell model techniques, either with large scale calculations or schematic models based in group theoretical classifications as well as within a collective description of the relevant degrees of freedom.
- Some phenomena related to octupole or tetrahedral degrees of freedom are more noticeable at the onset of quadrupole deformation regions. We are using our experience on these types of excitations to find a relation between the relative influence of the $T=1$ and $T=0$ channels of the nuclear interaction, the effects of octupole components in the deformed systems and the alpha-like correlations.
- It has been possible to study the thermal character of giant resonances built on top of nuclear excited states. From the experimental data of giant dipole resonances results an excess of low energy photons, which is at odds with the predictions of simple models.
- The existence of neutron skin in neutron rich nuclei has been studied in connection with the excitation of isovector dipole and quadrupole giant modes via isoscalar nuclear probes. In the case of large neutron excess, important contributions are obtained for the nuclear excitation and constructive interference is found between nuclear and Coulomb contributions.

Chaos and complex systems

- **Quantum Maps**
Quantum maps provide the simplest, yet highly non-trivial, arena for the investigation of the quantum properties of chaotic systems. As simple models of Poincare sections of realistic Hamiltonians or of time dependent "kicked" systems, they provide a testing ground for semiclassical approximations, correlations, universalities, localization, etc. We have developed techniques for the construction, semiclassical behaviour and phase space description of the baker's map, the Smale horseshoe, cat maps, etc.
- **Quantum Billiards**
Billiards in 2-D provide some of the best realistic models where wave and particle behaviour can be studied and related. Besides their intrinsic theoretical interest they describe the behaviour of ballistic electrons in mesoscopic cavities or of light in optical microcavities. The group has studied extensively the highly excited spectrum of plane chaotic billiards and its semiclassical description in terms of periodic orbits. A very efficient "scaling" method for the precise calculation of very excited eigenstates has been developed, which is now the best available. A theory of short periodic orbits is under active development with aim of taming the exponential increase in the number of periodic orbits needed for the semiclassical description of spectral properties.
- **Quantum Algorithms**
Quantum algorithms of interest to quantum information can be viewed as unitary maps. Thus, we can apply semiclassical techniques, phase space analysis, and long time behaviour characteristics of quantum maps to the operation of quantum circuits, providing a novel approach in this area.
- **Transport Phenomena in Mesoscopic Systems**
Application of the general methods of chaotic dynamics to the study of mesoscopic systems. We have studied persistent currents and the effects of surface roughness in ballistic cavities and the statistical properties of the fluctuations in the total energy in a non-interacting fermion system.
- **Chaotic Scattering at the Nuclear Coulomb Barrier**
There are interesting and characteristic anomalies in the heavy ion cross sections and angular distributions at backwards angles that can be interpreted as arising from chaotic scattering due to the coupling of intrinsic and translational degrees of freedom at Coulomb barrier energies. We have modeled these processes and proposed experiments to test these characteristics.

Field theoretical methods in strongly interacting systems

- Several aspects of the strange baryon structure and interactions have been investigated within the framework of the SU(3) chiral topological soliton models. In particular, we have studied the amplitudes for non-leptonic weak decays, the nucleon-hyperon potentials and the one-loop corrections to the baryon masses. Using the same type of models we have also performed the analysis of the strange, charm and bottom multibaryon spectra for baryons numbers up to $B=9$. For this purpose, we have considered some ansätze for the chiral field based on rational maps.
- The properties of the skyrmions in 2+1 dimensions have been studied. Such systems are relevant to understand some features of the Quantum Hall Effect.
- Nuclear structure problems related to the description of the double beta decays have been investigated. Special attention was paid to the difficulties related to the treatment of the zero modes associated to the breaking of isospin symmetry. For this purpose a formalism based on the use of BRST symmetry was developed.
- Some properties of the QCD chiral phase transition at finite temperature and chemical potential using non-local extensions of the Nambu-Jona-Lasinio model. We have made predictions for the position of the tricritical point” (chiral limit) and the “end point”.
- The problem of the center of mass in many-body nuclear systems has been revisited. Once the counter terms needed to satisfy translational invariance were determined, collective variables have been introduced. The problems associated with the overcompleteness and divergencies were solved using BRST invariance. The formalism has been applied to the calculation of some electroweak operators relevant to muon-electron conversion process.
- Another topic, which has been extensively studied, is that of nuclear microscopical models and approximations in connection to their use in predictions for observables in exotic electroweak processes such as double beta decay.
- Investigations concerning the edge states in the fractional Quantum Hall Effect. In particular, different predictions of the two classes of theories currently used to describe these states have been studied. We have also considered a Chern-Simons theory in 2+1 dim to describe the quasiparticles in the Pfaffian states.

Inhomogeneous quantum fluids

The investigation of the structure and stability of helium systems is the object of many theoretical and experimental works. Mainly two different theoretical approaches for investigating helium systems have been successfully employed in the literature:

- A self-consistent variational formalism based on the use of interatomic potentials within the framework of the theory of correlated basis functions in conjunction with the hypernetted chain expansion.
- A semiphenomenological approach which uses a density functional. In this semiphenomenological description the energy of the systems is written in terms of a functional depending of the density.

Among the properties of inhomogeneous superfluid ^4He , we have mainly studied the stability of helium films. This feature is determined by variational properties of the chemical potential m which is introduced in order to impose the conservation of the particle number N when solving the equation for the density profile, and by the requirement of a negative surface tension.

The behavior of films adsorbed onto solid planar substrates of alkali metals has been studied. The calculations were carried out by using the density functional formalism. Results indicate that only the surface of Cs is not wetted by ^4He at $T=0$ K. Planar substrates of lighter alkali metals (i.e., Rb, K, Na, and Li) are wetted by planar films of liquid ^4He at $T=0$ K.

Finally, we have also focused our attention on helium systems with cylindrical geometry. In this case a stability criterion consistent with basic equations of the thermodynamics was derived.

“Non-leptonic hyperon weak decays in the Skyrme model revisited”

D. Gomes Dumm, A.J. García and N.N. Scoccola
Phys. Rev. D62 (2000) 14001

Non-leptonic hyperon weak decays are investigated in the SU(3) Skyrme model. We use a collective coordinate scheme, following the approach in which the symmetry breaking terms in the strong effective action are diagonalized exactly. To describe the weak interactions we use an octet dominated weak effective lagrangian that leads to a good description of the known 2π and 3π kaon decays. We show that the observed S-wave decays are reasonably well reproduced in the model. On the other hand, our calculated P-wave amplitudes do not agree with the empirical ones even though both pole and contact contributions to these amplitudes are properly taken into account. Finally, an estimate of the non-octet contributions to the decay amplitudes is presented.

“Structure of the vacuum states in the presence of isovector and isoscalar pairing correlations”

D.R. Bes, O. Civitarese, E.E. Maqueda and N.N. Scoccola
Phys. Rev. C61 (2000) 024315

The long standing problem of proton-neutron pairing and, in particular, the limitations imposed on the solutions by the available symmetries, is revisited. We look for solutions with non-vanishing expectation values of the proton, the neutron and the isoscalar gaps. For an equal number of protons and neutrons we find two solutions where the absolute values of proton and neutrons gaps are equal but have the same or opposite sign. The behavior and structure of these solutions differ for spin saturated (single l-shell) and spin unsaturated systems (single j-shell). In the former case the BCS results are checked against an exact calculation.

“Multibaryons with heavy flavors in the Skyrme model”

C.L. Schat and N.N. Scoccola
Phys. Rev. D61 (2000) 034008

We investigate the possible existence of multibaryons with heavy flavor quantum numbers using the bound state approach to the topological soliton model and the recently proposed

approximation for multiskyrmion fields based on rational maps. We use an effective interaction lagrangian which consistently incorporates both chiral symmetry and the heavy quark symmetry including the corrections up to order $1/m_Q$. The model predicts some narrow heavy flavored multibaryon states with baryon number four and seven.

“Multibaryons as symmetric multisyrmions”

J.P. Garrahan, M. Schwelling and N.N. Scoccola
Phys. Rev. D61 (2000) 014001

We study non-adiabatic corrections to multibaryon systems within the bound state approach to the SU(3) Skyrme model. We use approximate ansätze for the static background fields based on rational maps which have the same symmetries of the exact solutions. To determine the explicit form of the collective Hamiltonians and wave functions we only make use of these symmetries. Thus, the expressions obtained are also valid in the exact case. On the other hand, the inertia parameters and hyperfine splitting constants we calculate do depend on the detailed form of the ansätze and are, therefore, approximate. Using these values we compute the low lying spectra of multibaryons with $B \leq 9$ and strangeness 0, -1 and -B. Finally, we show that the non-adiabatic corrections do not affect the stability of the tetralambda and heptalambda found in a previous work.

“Multibaryons in the Skyrme Model”

N.N. Scoccola
Hadron Physics 1999 - AIP Conference Proc. 508 (2000) 63

Low-lying multibaryon configurations are studied within the bound state approach to the SU(3) Skyrme model. We use approximate ansätze for the static background fields based on rational maps which have the same symmetries of the exact solutions. To determine the explicit form of the collective Hamiltonians and wave functions we only make use of these symmetries. Thus, the expressions obtained are also valid in the exact case. On the other hand, the meson bindings, inertia parameters and hyperfine splitting constants we calculate do depend on the detailed form of the

ansätze and are, therefore, approximate. Using these values we compute the low-lying spectra of multibaryons with $B \leq 9$ and strangeness 0 and $-B$. With these results the stability of some multilambda configurations is discussed.

“Electromagnetic and Weak Decays of Hyperons in the Skyrme Model”

N.N. Scoccola

Progress in Particle and Nuclear Physics **44** (2000) 243

We report on the result of some investigations concerning the radiative decays of decuplet baryons and the non-leptonic weak decays of the octet baryons in the context of topological chiral soliton models. Our results are compared with those of alternative baryon models. For the radiative decays we find that the predictions are similar to those of quark models. In the case of the non-leptonic weak decays, we find that although the predicted S-wave amplitudes are in rather good agreement with the observed values, the model is not able to reproduce the empirical P-wave amplitudes. Thus, in contrast to previous expectations, the Skyrme model does not seem to provide a solution to the long-standing 'S-wave/P-wave puzzle'.

“Multibaryons in the collective coordinate approach to the SU(3) Skyrme model”

C.L. Schat and N.N. Scoccola

Phys. Rev. D **62** (2000) 074010

We obtain the rotational spectrum of strange multibaryon states by performing the SU(3) collective coordinate quantization of the static multi-Skyrmions. These background configurations are given in terms of rational maps, which are very good approximations and share the same symmetries as the exact solutions. Thus, the allowed quantum numbers in the spectra and the structure of the collective Hamiltonians we obtain are also valid in the exact case. We find that the predicted spectra are in overall agreement with those corresponding to the alternative bound state soliton model.

“Comparison of density-functional approaches and Monte Carlo simulations for free planar films of liquid ^4He ”

L. Szybisz

European Physical Journal B **14** (2000) 733

Density functionals proposed in the literature for describing the behaviour of liquid helium at $T=0$ K are examined. In so doing, several properties of the ground states of free films of superfluid ^4He are calculated by using zero- and finite-range density functional theories and these results are compared to that computed with Monte Carlo simulations. We mainly focus the attention on the energy per particle of the slabs, the surface tension and the width of the liquid-vacuum interfaces, all as a function of the inverse of coverage. The largest differences are found in the case of the surface widths.

“Liquid-drop-like model for cylindrical helium systems”

L. Szybisz

Physica A **283** (2000) 193

Free liquid ^4He at $T=0$ K with cylindrical symmetry is studied. The ground-state energy and chemical potential are computed by using a density functional approach. A liquid-drop-like model is formulated for analyzing the behavior of these observables as a function of the size of the systems. It is shown that such a model allows to get precise information about the asymptotic values of the energy per particle and surface tension.

“Wetting of potassium surfaces by superfluid ^4He : A study using variational properties of the chemical potential”

L. Szybisz

Phys. Rev. B **62** (2000) 3986

The wetting of planar surfaces of K by superfluid ^4He films at $T=0$ K is theoretically studied. In order to examine the consistency of numerical results new variational properties of the chemical potential, μ_{are} are derived. Two substrate-adsorbate interactions are analyzed: (a) the standard “3-9” one and (b) the more elaborated potential recently proposed by Chizmeshya, Cole, and Zaremba (CCZ). New results calculated within the framework of two different nonlocal density functionals (namely, those known as the Orsay-Paris and Orsay-Trento formalisms) are reported. It is demonstrated that, the numerical solutions

obtained from the theoretical equations verify with high accuracy the derived variational conditions. The main output of this investigation is the finding that, for both analyzed adsorption potentials, thick enough helium films exhibit a positive square of the third-sound velocity. The wetting of a potassium substrate by superfluid ^4He at $T=0$ K suggested by experimental data is guaranteed in the case of the recent CCZ potential.

“Wetting of planar substrates of rubidium by liquid films of ^4He ”

L. Szybisz

Phys. Rev. B62 (2000) 12381

The wetting of planar solid surfaces of Rb by superfluid ^4He films at $T=0\sim\text{K}$ is examined theoretically the calculations were carried out by (i) using the most elaborated nonlocal density functional known as the Orsay-Trento proposal and (ii) assuming that the helium atoms interact with the substrate via the potential recently worked out by Chizmeshya, Cole, and Zaremba. The asymptotic surface tension was evaluated by applying two different procedures. Our results indicate that films of ^4He wet Rb at zero absolute temperature.

“Quantization of multidimensional cat maps”

A.M.F. Rivas, M. Saraceno and A.M. Ozorio de Almeida

Nonlinearity 13 (2000) 341

In this work we study cat maps with many degrees of freedom. Classical cat maps are classified using the Cayley parametrization of symplectic matrices and the closely associated center and chord generating functions. Particular attention is dedicated to loxodromic behavior, which is a new feature of two-dimensional maps. The maps are then quantized using a recently developed Weyl representation on the torus and the general condition on the Floquet angles is derived for a particular map to be quantizable. The semiclassical approximation is exact, regardless of the dimensionality or of the nature of the fixed points.

“Semiclassical quantization with short periodic orbits”

E.G Vergini and G.G Carlo

J.Phys. A 33 (2000) 4717

We apply a recently developed semiclassical theory of short periodic orbits to the stadium billiard. We give explicit expressions for the resonances of periodic orbits and for the application of the semiclassical Hamiltonian operator to them. Then, by using the 3 shortest periodic orbits and 2 more living in the bouncing ball region, we obtain the first 25 odd-odd eigenfunctions with surprising accuracy.

“Semiclassical Theory of Short Periodic Orbits in Quantum Chaos”

E.G Vergini

J. Phys. A33 (2000) 4709

We have developed a semiclassical theory of short periodic orbits to obtain all quantum information of a bounded chaotic Hamiltonian system. If T_1 is the period of the shortest periodic orbit, T_2 the period of the next one and so on, the number $N_{p,o}$ of periodic orbits required in the calculation is such that $T_1+\dots+T_{N_{p,o}}\cong T_H$, with T_H the Heisenberg time. As a result $N_{p,o}\cong h T_H \Delta \ln(h T_H)$, where h is the topological entropy. For methods related to the trace formula $N_{p,o}\cong \exp(h T_H)/(h T_H)$.

“Classical invariants and the quantum-classical link”

D. Wisniacki and E. Vergini

Phys. Rev. E62 (2000) R4513

The classical invariants of a Hamiltonian system are expected to be derivable from the respective quantum spectrum. In fact, semiclassical expressions relate periodic orbits with eigenfunctions and eigenenergies of classical chaotic systems. Based on trace formulae, we construct smooth functions highly localized in the neighborhood of periodic orbits using only quantum information. Those functions show how classical hyperbolic structures emerge from quantum mechanics in chaotic systems. Finally, we discuss the proper quantum-classical link.

“Beyond the First Recurrence in Scar Phenomena”

D. Wisniacki, F. Borondo, E. Vergini and R.M. Benito

Phys. Rev. E **62** (2000) R7583

The scarring effect of short unstable periodic orbits up to times of the order of the first recurrence is well understood. Much less is known, however, about what happens past this short-time limit. By considering the evolution of a dynamically averaged wave packet, we show that the dynamics for longer times is controlled by only a few related short periodic orbits and their interplay.

“Cylindrical Sources in Full Einstein and Brans-Dicke Gravity”

A. Arazi and C. Simeone.

General Relativity and Gravitation **32** (12) (2000) 2259

It was shown by Hiscock that the energy-momentum tensor commonly used to model local cosmic strings in linearized Einstein gravity can be extended and used in the full theory, obtaining a metric in the exterior of the source with the same deficit angle. Here we show that this tensor is an exception within a family for which a static solution does not exist in full Einstein nor in Brans-Dicke gravity.

“Wiggly Strings in Linearized Brans-Dicke Gravity”

A. Arazi and C. Simeone.

Mod. Phys. Lett. A **15** (21) (2000) 1369

The metric around a wiggly cosmic string is calculated in the linear approximation of Brans-Dicke theory of gravitation. The equations of motion for relativistic and non-relativistic particles in this metric are obtained. Light propagation is also studied and it is shown that photon trajectories can be bounded.

“Global Phase Time and Path Integral for the Kantowski-Sachs Anisotropic Universe”

C. Simeone

General Relativity and Gravitation **32** (9) (2000) 1835

The action functional of the anisotropic Kantowski-Sachs cosmological model is turned into that of an ordinary gauge system. Then a global phase time is identified for the model by imposing canonical gauge conditions, and the quantum transition amplitude is obtained by means of the usual path integral procedure of Fadeev and Popov.

Data Communication, Data Acquisition and Computational facilities

Our duty is to support and develop the Physics Department computer network (hardware and general facilities like mail, print, file and web servers and common applications) and the links with the other networks within CNEA and the Internet.

During 2000 we made improvements in the network, added new equipment and kept the available equipment in working conditions. This work was done within a frame of limited funding available.

Data Communication

This is the main area for our efforts, to keep the network working and improve the services it provides. There are currently 165 hosts on the network, with about 135 operating daily.

On Sep 2nd, 2000 we replaced the old SUN Sparc-10 server with a new SUN Ultra-10 multipurpose server, with updated software.

Another SUN Ultra-10 belonging to the Theoretical Physics group was also commissioned.

We took steps towards monitoring our Internet link, using tools originated in the PingER Project (<http://www-iepm.slac.stanford.edu/pinger/>). These tools were installed and operate in our site. Though PingER has limitations, it helped us to detect and characterize an atypical link failure during August 2000.

We added hubs and cabling for network access in the new laboratories in Building "B" and other sites both in Buildings "A" and "B". Coaxial cabling remaining elsewhere is being replaced by UTP.

As a first step, we installed an UPS for partial support of our network center.

Data acquisition and Computational facilities

The XSYS multiparameter data acquisition system supported on a microVAX 3300 and the microVAX 3100 are still in use.

The research groups within the Department kept buying new PCs and we put them to work. The older PCs were reassigned and reconfigured to suit the needs of their new users. We provided at least a first level of diagnostic and service (hardware and software). E-mail PC viruses are becoming a growing plague.

General support

Installation of "ispell", a multilingual typographical correction system for the UNIX environment.

Update and debugging for a facility to generate software packages to be installed on Solaris, Linux/SlackWare y Linus/RedHat platforms, starting with source code available in the public domain.

Development of an automated procedure in "perl" language to generate listings in HTML format. Specific implementation to keep track of the software available in our local repository.

Refurbishing and update of the Department's web page structure. Development of procedures to easy information publishing ('permanently updated report' for the Department's activities).

Everyday support duties, taking a sensible portion of available manpower, include:

- operating system maintenance ('patches' for SunOS, Solaris, Linux, etc.) and backups
- legacy systems maintenance (mainly PCs), with special efforts to obtain spare parts
- advice to users in network issues, data processing, maintenance procedures, equipment purchase, etc.

NOTE: This report does not include additional work in computing and data acquisition done by other groups in the Physics Department.

Contribution to Conferences

VII Workshop on Hadron Physics. Caraguatatuba, Río de Janeiro, Brasil. April 2000.

- “*Non-Leptonic Hyperons Decays in Soliton Models*”
D. Gómez Dumm, A.J. García and N.N. Scoccola

IIª Conferencia Argentina Multidisciplinaria sobre Cáncer - FACEC. Buenos Aires, Argentina. April 2000.

- “*Estudios Radiobiológicos con Haces Externos de Protones*”
J. Schuff, L. Policastro, A. Pérez de la Hoz, A. Burlón, M.E. Debray, J.M. Kesque, A.J. Kreiner, A. Mazal, H. Somacal, P. Stoliar, A. Valda Ochoa, S. Cáneva, S. Delacroix, F. Favaudon, Y. Henry, C. Nauraye, J.L. Habrand, O.A. Bernaola, H. Durán, B.L. Molinari, S. O’Connor, M. Palmieri, O. Opezzo, M. Ruffolo, G. Saint-Martin, F. Naab, M.J. Ozafrán, M.E. Vázquez, M. Davidson, J. Davidson

SILAF AE III. Cartagena de Indias, Colombia. April 2000.

- “*Effective Field Theory Approach to EW Corrections at LEP Energies*”
D. Gómez Dumm

Meeting of the American Physical Society. Long Beach, California, USA. April 2000.

- “*Spins of Low Lying States in ^{74}Br : A Prelude of Tests of the Standard V-A Model Using ^{74}Kr Recoil Correlations*”
M.M. Hindi, R.L. Kozub, S.J. Robinson, D.E. Di Gregorio, R. Joosten, R.M. Larimer, A.O. Macchiavelli, E.B. Norman, J Powell, G.R. Rech, M.W. Rowe, D. Ward
- “*Diamonds, Maybe, But Bismuth is Not Forever*”
E.B. Norman, E. Browne, D.L. Hurley, R.J. McDonald, A.R. Smith, D.E. Di Gregorio, I.D. Goldman

International Workshop on Quantum Dynamics in Terms of Phase-Space Distributions. Dresden, Germany. May 2000.

- “*Semiclassical Construction of Scar functions*”
G. Garlo and E. Vergini
- “*Classical Invariants and the Quantum-Classical link*”
D. Wisniacki and E. Vergini
- “*Quantum Dynamics in Terms of Phase-Space Distributions*”
G. Carlo and E. Vergini

1ra. Reunión de Trabajo de la Red Temática RICOMAI (Red Iberoamericana sobre Caracterización y Obtención de Materiales utilizando Aceleradores de Iones). La Habana, Cuba. May 2000.

- “*El Centro de Aceleración de Iones de Buenos Aires*”
A.J. Kreiner

International School of Physics and Astrophysics of Ultra High Energy Cosmic Rays. Observatoire de Meudon. Paris, France. June 2000.

- “*Trabajos realizados en el Laboratorio Tandem con el Detector Prototipo de Efecto Cerenkov*”
P.M. Bauleo

Reunión del Consejo Internacional de Finanzas del Proyecto Pierre Auger. CERN, Geneva, Switzerland. June 2000.

- “*La Situación Aduanera en Argentina y Trámites necesarios para el Ingreso de Equipamiento libre de Impuestos para el Observatorio del Proyecto Pierre Auger*”
A. Etchegoyen

International Conference in Solid Films and Surfaces (ICSFS). New Jersey, USA. July 2000.

- “*Diffusion Pathways of Si Ad-dimers on Si(001): A High Temperature Molecular Dynamics Study*”
C.C. Fu and M. Weissmann

The 7th International Symposium Olfaction & Electronic Nose (ISOEN). Brighton , United Kingdom. July 2000.

- “*Identification of Pollutant Gases and of their Concentrations using Multisensor Arrays*”
S. Reich, R.M. Negri, A. Lamagna and L. Dori

XIII Simposium Peruano de Física. Universidad Mayor de San Marcos, Lima, Perú. July 2000.

- “*Influencias de manejos de suelos vistos por Espectroscopía Mössbauer*”
Celia Saragovi. (Invited Talk).

Conferencia Internacional de Superficies. Princeton, USA. July 2000

- “*Difusión en la Superficie de Si(001)*”
C.C. Fu

Congreso Mundial de Física Médica y Bioingeniería. Chicago, USA. July 2000.

- “*Radiobiology Studies with External Proton Beams*”
J. Schuff, L. Policastro, A. Pérez de la Hoz, A. Burlón, M.E. Debray, J.M. Kesque, A.J. Kreiner, A. Mazal, H. Somacal, P. Stoliar, A. Valda Ochoa, S. Cáneva, S. Delacroix, F. Favaudon, Y. Henry, C. Nauraye, J.L. Habrand, O.A. Bernaola, H. Durán, B.L. Molinari, S. O’Connor, M. Palmieri, O. Opezzo, M. Ruffolo, G. Saint-Martin, F. Naab, M.J. Ozafrán, M.E. Vázquez, M. Davidson, J. Davidson

International Conference on Magnetism. Recife, Brazil. August 2000.

- “*Annealing effects on structural and magnetic properties of α -Fe₂O₃ nanoparticles*”
M. Vasquez-Mansilla, R.D. Zysler, C. Arcipestre, M. Dimitrijewitz, D. Rodriguez-Sierra, C. Saragovi
- “*From Direct to Inverse GMR: Introduction of Cr in Fe/Cu Superlattices*”
J. Milano and A.M. Llois
- “*Phase Separation in $La_{0.5}Ca_{0.5}MnO_3$* ”
F. Parisi, P. Levy, G. Polla, D. Vega, G. Leyva, H. Lanza, R.S. Freitas and L. Ghivelder
- “*Effects of Fe Doping in $La_{1/2}Ca_{1/2}MnO_3$* ”
P. Levy, L. Granja, E. Indelicato, D. Vega, G. Polla and F. Parisi
- “*Magnetism, Resistivity and Magnetoresistance in $Ca_{1-x}Y_xMnO_3$* ”
H. Aliaga, M.T. Causa, B. Alascio, H. Salva, M. Tovar, D. Vega, G. Polla, A.G. Leyva and P. Konig
- “*High Pressure Effects on the Resistivity and Ferromagnetic Transition of Ceramic Manganite $Ca_{1-x}Y_xMnO_3$* ”
G. Garbarino, S. Parón, M. Monteverde, C. Acha, A.G. Leyva, D. Vega, G. Polla, J. Briático, B. Alascio

Jornadas SAM 2000, IV Coloquio Latinoamericano de Fractura y Fatiga. Facultad de Ingeniería, Universidad Nacional del Comahue, Neuquen, Argentina. August 2000.

- “*Estudio de algunos intermetalicos en el sistema Zr-Nb-Fe utilizando Espectroscopia Mossbauer*”
C. Ramos, C. Saragovi, M. Granovsky and D. Arias
- “*Influencia de la implantación iónica sobre la tracción de películas de Al 8006*”
E. Povoletto, E.B. Hermida y A. Filevich

Psik-2000. Schwabisch-Gmundt, Germany. August 2000.

- “*Metales de Transición Adsorbidos en Oro*”
A.M. Llois and M. Weissmann
- “*Fulerenos Sustituidos con Silicio*”
C.C. Fu and M. Weissmann

International Symposium on the Industrial Applications of the Mössbauer Effect, ISIAME 2000. Virginia, USA, August 2000.

- “*Mössbauer Spectroscopy Studies of some Intermetallics in the Zr-Nb-Fe System*”
C. Ramos, C. Saragovi, M. Granovsky and D. Arias
- “*Characterisation of Laves Phases Zr (Cr, Fe)₂ Oxidized in an Open Furnace using Mössbauer Spectroscopy*”
F. Saporiti, P. Bozzano, R. Versaci, C. Ramos, I. Raspini and C. Saragovi
- “*A Mössbauer Study on Gray Stains in Electroplated Steel*”
M. Zapponi, T. Pérez, C. Ramos, G. Polla, C. Saragovi and D. Cook

The 12th International Conference on Ion Beam Modification of Materials. Canela, Brazil. September 2000.

- “*New Compact Design for an Ion Source*”
H. Huck, D.E. Di Gregorio, J.O. Fernández Niello, E.B. Halac, M. Igarzábal, J. Orecchia and M.E. Reinoso
- “*Diffusion of Tantalum in Alpha-Ti*”
G. García Bermúdez

XI Conferencia Europea de Diamante, Materiales Simil-Diamante, Nanotubos de Carbono, Nitruros y Carburos de Silicio. Porto, Portugal. September 2000.

- “*Amorphous Si_xC_{1-x} Films: An Example of Materials presenting Low Indentation Hardness and High Wear Resistance*”
J. Esteve, A. Lousa, E. Martinez, H. Huck, E.B. Halac, M.E. Reinoso

Reunión de la Asociación de Química Argentina (AQA). Corrientes, Argentina. September 2000.

- “*Especiación de As(III) y As(V) usando Saccharomyces Cerevisiae. Determinación por HG—ICP—AES*”
P. Smichowski, J. Marrero, A. Ledesma, G. Polla, D. Batisttoni

XXIV International Workshop on Condensed Matter Theories. Buenos Aires, Argentina. September 2000.

- “*The Treatment of Translational and Galilean Invariances in EI Transitions*”
D.R. Bes y O. Civitarese
- “*Espejismos Cuánticos en Sistemas de Metales de Transición Adsorbidos sobre Metales Nobles*”
M. Weissmann
- “*Simple model molecules for the condensed phases of sulfur*”
C. Pastorino and Z. Gamba

- “*Density functional formalism in the canonical ensemble*”
J.A. Hernando and L. Blum
- “*Density fluctuations and entropy*”
J.A. Hernando and L. Blum
- “*Modified virial series around non null density*”
I. Urrutia and J.A. Hernando
- “*A variational theory for Yukawa fluids: the equivalent mean spherical approach*”
L. Blum and J.A. Hernando. Invited talk

28th IEEE Photovoltaic Specialists Conference. Alaska, Anchorage, USA. September 2000.

- “*SAC-A satellite: First Experiment of Argentine Solar Cells in Space*”
C. Bolzi, C.J. Bruno, J.C. Durán, E.M. Godfrin, M.G. Martínez Bogado, L.M. Merino, J.C. Plá, M.J.L. Tamasi and M. Barrera

85^a Reunión Nacional de la Asociación Física Argentina. Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires. Buenos Aires, Argentina. September 2000.

- “*Destrucción del Orden de Carga por Dopaje con Fe en $La_{1/2}Ca_{1/2}MnO_3$* ”
L. Granja, E. Indelicato, F. Parisi, P. Levy, G. Polla, D. Vega, H. Lanza, L. Civale
- “*Memoria y Relajación en $La_{1/2}Ca_{1/2}MnO_3$* ”
J. Sacanell, P. Levy, F. Parisi, G. Polla, D.R. Vega
- “*Magnetoresistencia y Separaciones de Fases*”
J. Sacanell, P. Levy, F. Parisi, G. Polla, D.R. Vega, L. Granja, E. Indelicato
- “*Defectos Columnares como Detectores de Dirección de Campo Interno en Superconductores*”
A.V. Silhanek, L. Civale, J.A. Herbsommer, G.L. Nieva, J. Azcarate, P. Levy
- “*Análisis de Barreras de Fusión en Base al Comportamiento de Barreras de Potencial Modificadas por Acoplamiento entre Canales*”
M.R. Spinella, J.E. Testoni, O. Dragún and H.D. Marta
- “*Barreras de Fusión en los Sistemas $12,13C + 105,106Pd$ obtenidas a partir de medidas del Canal Cuasi-Elastico*”
O.A. Capurro, J.E. Testoni, D. Abriola, D.E. Di Gregorio, G.V. Martí, A.J. Pacheco, M.R. Spinella, E. Achterberg

- *“Comparación de las Distribuciones de Barreras de Fusión en el Sistema $^{32}\text{S} + ^{110}\text{Pd}$ obtenidas a partir de Medidas de Fusión y del Canal Cuasielástico”*
O.A. Capurro, J.E. Testoni, D. Abriola, D.E. Di Gregorio, G.V. Martí, A.J. Pacheco, M.R. Spinella
- *“Nuevo Sistema de Detección de Iones Pesados”*
O.A. Capurro, J.E. Testoni, G.V. Martí, M. Ramírez, D. Abriola, A. Arazi, D.E. Di Gregorio, J. O. Fernández Niello, A.J. Pacheco
- *“Cuerdas Cósmicas Wiggly”*
A. Arazi and C. Simeone
- *“Tiempo Global e Integral de Camino para Modelos Cosmológicos”*
C. Simeone, H. De Cicco and G. Giribet
- *“Estudios Radiobiológicos con Haces de Protones”*
J. Schuff, L. Policastro, A. Pérez de la Hoz, A. Burlón, M.E. Debray, J.M. Kesque, A.J. Kreiner, A. Mazal, H. Somacal, P. Stoliar, A. Valda Ochoa, S. Cáneva, S. Delacroix, F. Favaudon, Y. Henry, C. Nauraye, J.L. Habrand, O.A. Bernaola, H. Durán, B.L. Molinari, S. O’Connor, M. Palmieri, O. Opezzo, M. Ruffolo, G. Saint-Martin, F. Naab, M.J. Ozafrán, M.E. Vázquez, M. Davidson, J. Davidson
- *“Determinación Multielemental en Muestras de Líquido Sinovial aplicando PIXE”*
F. Naab, M. Ozafrán, G. Leyva, M. Vázquez, M.E. Caraballo, A. Burlón, M.E. Debray, A.J. Kreiner, J.M. Kesque, P. Stoliar, H. Somacal, A. Valda Ochoa, J. Schuff, M. Davidson, J. Davidson, G. Mora and M.A. Benyacar
- *“Diseño de un Blanco de Producción de Neutrones vía la Reacción $^7\text{Li}(p,n)^7\text{Be}$ cerca de la Energía Umbral para su aplicación BNCT (Boro Neutron Capture Therapy)”*
A. Burlón, A. Valda Ochoa, A.J. Kreiner, H. Somacal, M.E. Debray, P. Stoliar, J.M. Kesque, F. Naab, M. Ozafrán, J. Schuff, M. Vázquez, M. Davidson, J. Davidson, M.E. Caraballo
- *“Dosimetría en un Fantoma de Cerebro usando la Reacción $^{13}\text{C}(d,n)^{14}\text{N}$ para su Posible Aplicación en BNCT (Boro Neutron Capture Therapy)”*
A. Burlón, A.J. Kreiner, S. White, J.C. Yanch, B. Blackburn, D. Gierga
- *“Propuesta para un método remoto de calibración de intensidad de los detectores de superficie del Observatorio Auger”*
P. Bauleo, C. Bonifazi, A. Filevich and A. Reguera
- *“Películas Delgadas de SixC1-x Amorfo: Un Ejemplo de Materiales que presentan Baja Dureza y Alta Resistencia al Desgaste”*
J. Esteve, A. Lousa, E. Martinez, H. Huck, E.B. Halac, M. Reinoso
- *“Nuevas Fases Superduras de Fulleritas de C_{60} ”*
E. Burgos, E. Halac, R. Weht, H. Bonadeo, E. Artacho, P. Ordejón
- *“Efecto de Agregados de Nb en el Compuesto Zr_2Fe ”*
C. Ramos, C. Saragovi, M. Granovsky, D. Arias
- *“Estudio de la Oxidación de Fases de Laves del Sistema $\text{Zr}(\text{Cr}_x\text{Fe}_{1-x})_2$ ”*
P.A. Vázquez, F. Saporiti, C. Ramos, P. Bozzano, R. Versaci, C. Saragovi
- *“Estructura Electrónica, Efectos Térmicos y Cuánticos Nucleares en el Sistema lialh_4 ”*
E. Ascitutto, D.A. Estrin, R. Weht

- “*Interacciones Locales en el Juego de la Minoría*”
D. I. Caridi, H. Ceva
- “*Series del Virial en Torno de Densidad y Fugacidad No Nulas*”
I. Urrutia, J. Hernando
- “*Decoherencia en el Mapa Cuántico del Panadero*”
P. Bianucci, J.P. Paz, M. Saraceno
- “*Cáusticas en la Ecuación Diferencial de Tercer Orden*”
F. Parisi, M. Iriondo, C.N. Kozameh, D. M. Forni
- “*Calibración Remota de los Detectores de Efecto Cerenkov usando el Fondo de Radiación Cósmica*”
P. Bauleo, C. Bonifazi, A. Filevich, A. Reguera
- “*Decaimientos Débiles No-Leptónicos de Hiperones en el Modelo de Skyrme*”
A. García, D. Gómez Dumm, N.N. Scoccola
- “*Restauración de Simetría Quiral a Temperatura y Densidad Finita en un Modelo de Nambu-Jona-Lasinio Generalizado*”
I. General, D. Gómez Dumm, N.N. Scoccola
- “*Cálculo de Propiedades Electrónicas y Magnéticas del Fe BCC y de la Super Red Fe/Au*”
G. Chao, S. Di Napoli, D.A. Estrin, A.M. Llois
- “*Cu_{1-x}M_x(HCOO)₂·2H₂O, (M=Mn, Co, Ni, Cd): Estructura Cristalina y Comportamiento Térmico*”
A.G. Leyva, G. Polla, D. Vega, R. Baggio, P.K. de Perazzo, M.A. de Benyacar, M.T. Garland
- “*Estudio del Sistema Y_{1-x}Cd_xMnO₃ (0 < x < 1)*”
O. Agüero, A.G. Leyva, P. König, P. Levy, G. Polla
- “*Un Potencial Anisotrópico para las Fases Cristalinas del Azufre*”
C. Pastorino, Z. Gamba
- “*Componentes Armónicas en una Red de Ising con Desorden Modulado*”
V. Massidda
- “*Sistemas Cilíndricos de ⁴He Líquido*”
S.M. Gatica, L. Szybisz
- “*Mojado de Superficies de Metales Alcalinos Pesados por ⁴He Líquido*”
L. Szybisz
- “*Sistemas de Espines no Colineales: Propiedades de Transporte*”
S. Di Napoli, A. M. Llois
- “*De GMR directa a Inversa: Introducción de Cr en Superredes Fe/Cu*”
J. Milano, A. M. Llois, L. Steren
- “*Propiedades de Transporte de Sistemas Granulares y Multicapas formados por Agregados de Co Embebidos en Ag*”
J. Milano, A.M. Llois, L. Steren
- “*Interacción de Estados de Superficie con Defectos Superficiales*”
M.A. Barral, A.M. Llois

- *“Estructura y Propiedades Magnéticas de Nanopartículas de Hematita Tratadas Térmicamente”*
C. Saragovi, D. Rodriguez-Sierra, R.D. Zysler, M. Vasquez-Mansilla, C. Arciprete, M. Dimitrijewits
- *“Orden de Carga en $Ca_{0.5}Y_{0.5}MnO_3$: Estudio Magnetoestructural”*
H. Aliaga, D. Vega, M.T. Causa, M. Tovar, B. Alascio, G. Polla, A.G. Leyva, P. Konig
- *“Evolución de Magnetismo del Ce en los Sistemas $Ce(Pr_{1-x}M_x)$ ($M=Rh, Ni$ y Ag)”*
V.L. Vildosola, A.M. Llois, M. Weissmann, J.G. Sereni
- *“Efecto de Aplicar Altas Presiones en la Resistividad y en la Transición Ferromagnética de $Ca_{1-x}Y_xMnO_3$ ”*
G. Garbarino, S. Parón, A.G. Leyva, D. Vega, G. Polla, C. Acha
- *“Efectos del Doble Intercambio en el Magnetismo de la Manganita Dopada con Electrones: $Ca_{1-x}Y_xMnO_3$ ”*
H. Aliaga, M.T. Causa, B. Alascio, H. Salva, M. Tovar, D. Vega, G. Polla, G. Leyva, P. Konig
- *“Medición de Radioisótopos de Vida Media Larga en el Meteorito de Campo del Cielo”*
R.G. Liberman, J.O. Fernández Niello.
- *“Espectroscopía de Iones Pesados con un Detector de Bragg”*
D. Abriola, A. Arazi, O.A. Capurro, J.O. Fernández Niello, A.M.J. Ferrero, R.G. Liberman, G. V. Martí, M. Ramírez, A.J. Pacheco, J.E. Testoni
- *“Estudio del Mecanismo de Captura de Impurezas en el Proceso de Elaboración de Celdas Solares mediante el Método OCVD”*
M.G. Martínez Bogado, M.J.L. Tamasi, J.C. Plá, C.G. Bolzi, C.J. Bruno, S.E. Rodríguez, J.C. Durán
- *“Primeros Ensayos en el País de Daño por Radiación en Celdas Solares de Silicio”*
M.P. Barrera, J.C. Durán
- *“Evaluación del Funcionamiento de las Celdas Solares Argentinas durante la Misión del Satélite SAC-A”*
E.M Godfrin, J.C. Durán
- *“Nariz Electrónica utilizando Sensores Micromaquinados para Gases de Interés Ambiental”*
C. Arrieta, J. Gimenez, M. Negri, S. Reich, A. Lamagna
- *“Sensores de Gas de Película Delgada de SnO_2 sobre Substrato de Silicio Micromaquinado”*
C. Arrieta, L. Dori, S. Duhalde, J. Gimenez, A. Lamagna, L. Quintero
- *“Algoritmo Genético: Los Cromosomas y su Evolución al Servicio de la Física”*
P. A. Vázquez, D. Abriola

XXIII Reuniao de Trabalho em Física Nuclear no Brazil y Primer Simposio Latinoamericano de Física Nuclear. Campinas, San Pablo, Brazil. September 2000.

- *“Gamma-Radioactivity in Natural Bismuth”*
E. Browne, E.B. Norman, D.L. Hurley, R.J. MacDonald, A.R. Smith, D.E. Di Gregorio and I.D. Goldman

Solar Cell Calibration and Measurements Workshop. Alaska, Girdwood, USA. September 2000.

- “SAC-A satellite: first experiment of Argentine solar cells in space”
E. Godfrin

Ninth International Symposium on Neutron Capture Therapy for Cancer. Osaka, Japan. October 2000.

- “In-Phantom Dosimetry using the $^{13}\text{C}(d,n)^{14}\text{N}$ Reaction for BNCT”
A. Burlón, A.J. Kreiner, S. White, B. Blackburn, D. Gierga and J.C. Yanch

Symposium of Northeastern Accelerator Personnel. University of Yale. New Haven, Connecticut, USA. October 2000.

- “Descripción de las Actividades del Acelerador Tandem en relación al trabajo del Acelerador Electrostático de Iones Pesados”
C.A. Miguez

Workshop on Relativistic Aspects of Nuclear Physics. Caraguatatuba, Río de Janeiro, Brazil. October 2000.

- “Chiral Phase Transition in a Covariant Nonlocal NJL Model”
I. General, D. Gómez Dumm and N.N. Scoccola

VII International Conference on Hypernuclear and Strange Particle Physics. Torino, Italy. October 2000.

- “Strange Multibaryons in Topological Soliton Models”
N.N. Scoccola

XXIII Reunión de Trabajo de la Asociación Argentina de Energías Renovables y Ambiente y IX Encuentro de la Asociación Internacional para la Educación en Energía Solar IASEE (ASADES 2000). Resistencia, Argentina. October 2000.

- “Determinación de Parámetros Característicos de Celdas Solares en el Espacio a partir de Mediciones recibidas por Telemetría”
E.M. Godfrin, M.G. Martínez Bogado, M.J.L. Tamasi and J.C. Durán
- “Influencia de la Difusión de Aluminio y Fósforo sobre la Vida Media de Portadores Minoritarios en Obleas de Silicio Cristalino”
M.G. Martínez Bogado, M.J.L. Tamasi, J.C. Plá, C.G. Bolzi and J.C. Durán

**Seminario Latinoamericano de Análisis por Técnicas de Rayos X (SARX'2000).
Campinas, San Pablo, Brazil. November 2000.**

- “*Caracterización por Microscopía Electrónica de Barrido y de Alta Resolución de la Incorporación de AS(III) en Saccharomyces Cerevisiae*”
G. Polla, P. Smichowski, J. Marrero, A. Ledesma, H. Lanza and D. Batistoni
- “*Estudio por Difracción de Rayos X del Diagrama de Fases del Sistema $SrMnO_3 - YmnO_3$* ”
D. Vega, G. Polla, A.G. Leyva, P. Konig and P. Levy
- “*Rayos X Inducidos por ^{12}C sobre Distintos Elementos*”
M.J. Ozafrán, M.E. Debray, R. Eusebi, A. Burlón, A.J. Kreiner, P. Stoliar and M.E. Vázquez

IBERSENSOR 2000. Buenos Aires, Argentina. November 2000.

- “*SnO₂ Thin Film Gas Sensor on Micromachined Si*”
C. Arrieta, S. Duhalde, J. Gimenez, A. Lamagna, L. Quintero
- “*Preliminary Results of a First Prototype of an E-Nose for Indoor Air Quality Control*”
R. Marabini, C. Arrieta, S.L. Reich, M. Negri, L. Dori, J. Gimenez, A. Lamagna

Reunión Anual de la Asociación Argentina de Tecnología Nuclear (AATN). Buenos Aires, Argentina. November 2000.

- “*Retención de Uranio en Suspensiones Acuosas de Hidroxiapatita*”
A.G. Leyva.
- “*Dosimetría en un Fantoma de Cerebro usando la Reacción $^{13}C(d,n)^{14}N$ para su Posible Aplicación en BNCT (Boro Neutron Capture Therapy)*”
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Seminars 2000

- 25/4 *Efectos de Envejecimiento en Vidrios de Espín Cuánticos*
G. Lozano, Department of Physics, UBA
- 16/5 *Applications of 3D Computed Tomography*
F. Casali, Department of Physics, University of Bologna, Italy
- 23/5 *Sistemas de Reacción-Difusión con Múltiples Escalas Temporales: El Caso del Calcio Intracelular*
S. Ponce Dawson, Department of Physics, UBA
- 30/5 *Astronomía Gravitacional: Nuevos Observatorios y Algo de Teoría*
P. Marronetti, University of Texas, Austin, USA
- 5/6 *Mössbauer Spectroscopy on Materials in Relation with Magnetism*
R. E. Vanderberghe, University of Gent, Belgium
- 6/6 *Algunos Aspectos de las Computadoras Cuánticas*
M. Saraceno, Department of Physics, CNEA
- 13/6 *Teorías Efectivas del Efecto Hall Cuántico*
G. Zemba, Department of Physics, CNEA
- 27/6 *Evolución de Proteínas*
J. Echave, Universidad Nacional de Quilmes
- 4/7 *Escenarios Energéticos*
R. Pedace, Centro de Estudios Avanzados, UBA
- 1/8 *Baldwin y el Neo-Lamarckismo: Interacción del Aprendizaje y de la Evolución Biológica*
R. Perazzo, Centro de Estudios Avanzados, UBA
- 8/8 *Que hay de Nuevo bajo el Sol?*
J. C. Durán, Department of Physics, CNEA
- 10/8 *Conversación sobre el Esquema propuesto para el Financiamiento de la Ciencia*
H. Herzer, Oficina Nacional de Investigaciones Científicas, SECyt
- 15/8 *Un Modelo de Redes Neuronales del Aprendizaje Aversivo*
S. Zanutto, Facultad de Ingeniería, UBA
- 22/8 *Control de Calidad en el Plegamiento de Glicoproteínas*
A. Parodi, Investigaciones Biotecnológicas, UNSaM
- 29/8 *Proyecto Pierre Auger*
E. Roulet, Universidad Nacional de La Plata
- 4/9 *Magnetic Properties of Ultrathin Films and Multilayers*

M. Przybylski, Max-Planck Institut fuer Mikrostrukturphysik, Halle, Germany

- 5/9** ***Legislación para el Area de Ciencia y Tecnología***
A. Puiggrós, Comisión de Ciencia y Técnica de la Honorable Cámara de Diputados de la Nación
- 26/9** ***Radiación Cósmica en Materiales Extraterrestres: El Caso del Meteorito de Campo del Cielo***
R. Liberman, Department of Physics, CNEA
- 3/10** ***Tiempo de Respuesta Humana ante Decisiones Binarias. Resultados Experimentales Preliminares***
J. Codnia, Universidad Nacional de General Sarmiento
- 17/10** ***Materiales Superduros. Realidad o Alquimia Computacional***
H. Huck, Department of Physics, CNEA
- 24/10** ***Efectos del Confinamiento sobre las Corrientes persistentes de los Sistemas Metálicos***
M. J. Sanchez, Department of Physics, UBA
- 31/10** ***Procesos que Determinan el Crecimiento de Films Delgados de Silicio***
M. Weissmann and Chu Chun Fu, Department of Physics, CNEA
- 7/11** ***Utilización de Aceleradores para la Terapia por Captura Neutrónica***
A. Burlón, Department of Physics, CNEA
- 14/11** ***Poder de Frenamiento Molecular, Ventajas sobre el Atómico***
M. Behar, Universidad Federal do Rio Grande do Sul, Porto Alegre, Brazil
- 21/11** ***Regulación de Síntesis de ADN***
S. Yakisich, School of Science and Technology, UNSaM
- 5/12** ***Accelerators for Boron Neutron Capture Therapy***
W. Chu, Lawrence Berkeley Laboratory, USA
- 12/12** ***Estudios de Contaminación Atmosférica en la Ciudad de Buenos Aires***
M Negri, INQUIMAE, UBA
- 19/12** ***Balance 2000 del Departamento de Física***
A.J. Pacheco, Department of Physics, CNEA

Visitors

- A. Barnett Physics Department, Harvard University, Boston, USA.
- J.P. Blaizot Service de Physique Theorique (CEA), Saclay, France.
- L. Blum Universidad de Puerto Rico, San Juan, Puerto Rico.
- F. Borondo Universidad Autónoma de Madrid, Madrid, Spain.
- D. Camín Università Degli Studi di Milano, Milano, Italy.
- T. Cecchine Pontificia Universidad Católica de Rio Grande do Sul, Porto Alegre, Brazil.

- E. Centurioni LAMEL-CNR, Bologna, Italy.
- M.Cocco Technobiochip SRL, Bologna, Italy.
- A.Cuevas National University of Australia, Canberra, Australia.
- C.H. Dasso Facultad de Física Atómica Molecular y Nuclear, Universidad de Sevilla, Sevilla, Spain.

- H. Forkel University of Heidelberg, Heidelberg, Germany.
- L. Ghivelder Laboratorio de Bajas Temperaturas, Universidad Federal de Rio de Janeiro, Río de Janeiro, Brazil.

- M. Graessel Fachhochschule Osnabrück, Germany
- D. Jamieson University of Melbourne, Melbourne, Australia.
- G. Korschinek Technische Universitaet Muenchen, Munich, Germany.
- M. Lapolla Università degli Studi di Milano, Milano, Italy.
- D. Macdonald National University of Australia, Canberra, Australia.
- A.P. Mallmann Pontificia Universidad Católica de Rio Grande do Sul, Porto Alegre, Brazil.

- H. D. Marta Facultad de Ingeniería de la Universidad de La República, Montevideo, Uruguay.

- M. Martins Coimbra Universidade Estadual Londrina, Londrina, Brazil..
- A. D. Mazal Institut Curie, Paris, France.
- R. Meigikos Universidad Federal Fluminense, Niteroi, Brazil.
- A. Moehlecke Pontificia Universidad Católica de Rio Grande do Sul, Porto Alegre, Brazil.

- C. Muri Pinto Universidad Federal Fluminense, Niteroi, Brazil.
- S. Nicoletti LAMEL-CNR, Bologna, Italy.
- S. Nonnenmacher Service de Physique Theorique (CEA), Saclay, France.
- I Padrón Díaz Universidad Federal Fluminense, Niteroi, Brazil.
- A. Pan Pontificia Universidad Católica de Rio Grande do Sul, Porto Alegre, Brazil.

- Marek Przybylski Max-Planck Institut fur Mikrostrukturphysik, Halle, Germany.
- C. Rodriguez Ramo Pontificia Universidad Católica de Rio Grande do Sul, Porto Alegre, Brazil.

- A. Roncaglia Dept.of Electronics (DEIS), Universita di Bologna, Bologna, Italy.
- F. Rubinelli INTEC, Santa Fé, Argentina.
- C.L. Schat Centro Brasileiro de Pesquisas Fisicas, Río de Janeiro, Brazil.
- T. Severo Pontificia Universidad Católica de Rio Grande do Sul, Porto Alegre, Brazil.

- P.R. Silveira Gomes Universidad Federal Fluminense, Niteroi, Brazil.
- C. Summonte LAMEL-CNR, Bologna, Italy.
- W. Tongil Chu Lawrence Berkeley National Laboratory,USA.
- R. E. Vandenberghe NUMAT, University of Gent, Gent, Belgium.
- C. Wallgner Technische Universitaet Muenchen, Munich, Germany.
- R. Zysler Centro Atómico Bariloche, S.C.de Bariloche, Río Negro, Argentina.

Visits

- A. Arazi Technische Universitaet Muenchen, Munich, Germany.
- R.F. Baggio Universidad Nacional de la Patagonia San Juan Bosco, Puerto Madryn, Chubut, Argentina.
- R.F. Baggio Laboratorio de Cristalografía, Universidad de Chile, Santiago de Chile, Chile.
- P.M. Bauleo Instituto Politécnico de Nova Gorica, Nova Gorica, Slovenia.
- C. Bruno LAMEL-CNR ,Bologna, Italy.
- A. Burlón LABA, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA.
- M.C. Cambiaggio Centro Atómico Bariloche, S.C.de Bariloche, Río Negro, Argentina.
- M.A. Cardona Instituto de Física Nuclear, Laboratorio Nacional de Legnaro, Legnaro, Italy.
- G. Carlo Max Planck Institute for the Physics of Complex Systems, Dresden, Germany.
- J.C. Durán INVAP S.E, S. Carlos de Bariloche, Río Negro, Argentina.
- J. O. Fernández Niello Technische Universitaet Muenchen, Munich, Germany.
- J.O. Fernández Niello Universidad Federal Fluminense, Niteroi, Río de Janeiro, Brazil.
- A. Filevich Universidad Federal de Rio Grande Do Sul, Porto Alegre, Brazil.
- C.C. Fu Centre de Recherche Sur Les Mecanismos de la Croissance Cristalline, Marseille, France.
- Z. Gamba Dept. of Physics, University of Puerto Rico.
- D. Gómez Dumm Facultad de Física, Universidad de Valencia, Valencia, Spain.
- J. Hernando Dept. of Physics, University of Puerto Rico.
- D.L. Hojman Instituto de Física Nuclear, Laboratorio Nacional de Legnaro, Legnaro, Italy.
- A. J. Kreiner Laboratorio de Aplicaciones de Aceleradores, Massachusetts Institute of Technology, Boston, USA.
- A. Lamagna LAMEL-CNR, Bologna, Italy.
- P. Levy Laboratorio Propiedades Magnéticas, Universidad Federal de Rio de Janeiro, Rio de Janeiro, Brazil.
- P. Levy Imperial College of Science, Technology and Medicine and Department of Materials Science, University of Cambridge, Cambridge, United Kingdom.
- P. Levy CNR- Istituto di Spettroscopia Molecolare, Bologna, Italy.
- A.M. Llois Departamento de Física, Universidad Católica de Chile, Chile.
- E.E. Maqueda Departamento de Física, Galileo Galilei, Università di Padova, Padova, Italy.
- G.V. Martí Universidad Federal Fluminense, Niteroi, Río de Janeiro, Brazil.
- G.V. Martí Laboratório Pelletron, Universidade Sao Paulo, Sao Paulo, Brazil.
- M.G. Martínez Bogado Pontificia Universidade Católica do Rio Grande do Sul, Porto Alegre, Brazil.
- J. Milano Centro Atómico Bariloche, S.C.de Bariloche, Río Negro, Argentina.
- J. Milano Abdus Salam International Centre for Theoretical Physics, Trieste, Italy.
- A. J. Pacheco Universidade Sao Paulo, Sao Paulo, Brazil.
- C. Pastorino International School of Physics Enrico Fermi, Varenna, Italy.
- M. Saraceno IPN, Université Paris Sud, Orsay, France.
- M. Saraceno Service de Physique Theorique (CEA), Saclay, France.
- N.N. Scoccola Universidade Estadual do Río de Janeiro, Río de Janeiro, Brazil.
- N.N. Scoccola Thomas Jefferson National Accelerator, Newport News, Virginia, USA.
- H. M. Sofia Departamento de Física, Galileo Galilei, Università di Padova, Padova, Italy.
- H.M. Sofia Universidad de Sevilla, Sevilla, Spain.
- M.J.L. Tamasi LAMEL-CNR, Bologna, Italy.
- D.R. Vega Johns Hopkins University, Baltimore, Atlanta, USA.

- D.R. Vega Laboratorio de Cristalografía, Universidad de Campinas, Campinas, Sao Paulo, Brazil.
- R. Weht Institut de Ciencia de Materials, Barcelona (ICMAB). Barcelona, Spain.
- D. Wisniaki Grupo de Caos y Dinámica No Lineal, Universidad Autónoma de Madrid, Madrid, Spain.
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Theses

Ph.D. Theses

- **Fernando P. Simonotti.** “*Autofunciones del Billar de Bunimovich en Representacion de Estados Coherentes*”
Universidad de Buenos Aires-March 2000.
Advisor: M. Saraceno
- **Marina Huerta.** “*Teorías de Campos Efectivos del Efecto Hall Cuántico*”
Universidad Nacional de Cuyo-May 2000.
Advisor: G. Zemba
- **Gabriel Carlo.** “*Aproximación Semiclásica de Sistemas Caóticos*”
Universidad de Buenos Aires-November 2000.
Advisor: E. Vergini
- **Gad Levinton.** “*Bandas Rotacionales Gemelas No-Idénticas*”
Universidad de Buenos Aires-December 2000.
Advisor: A. J. Kreiner
- **Fabián U. Naab.** “*Análisis de Trazas de Elementos Contaminantes o Tóxicos en Muestras Biológicas empleando la Técnica PIXE*”
School of Science and Technology, UNSaM-December 2000.
Advisor: A. J. Kreiner

Licenciatura (Master) Theses

- **Marcela P. Barrera.** “*Estudio del Daño por Radiación en Celdas Solares de Silicio para Uso Espacial*”
Universidad de Buenos Aires-August 2000.
Advisor: J. C. Durán
- **Ignacio Urrutia.** “*Expansion del Virial alrededor de densidades no nulas*”
Universidad de Buenos Aires-August 2000.
Advisor: J. Hernando
- **Pablo Bianucci.** “*Decoherencia en Mapas Cuanticos*”
Universidad de Buenos Aires-December 2000.
Advisor: M. Saraceno and J.P.Paz

Maestria

- **Liliana Morales.** “*Influencia de la Sustitucion de Sn en las Propiedades Estructurales y Magneticas de LaMnO3*”
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- *Elementos de Fisica Nuclear.* J. Testoni. School of Science and Technology, UNSaM
- *Algunas Tecnicas Experimentales en Materia Condensada.* E. Burgos, E.B.Halac and C.Saragovi. School of Science and Technology, UNSaM
- *Teorias de Campos Conformes.* G.Zemba. School of Science and Technology, UNSaM
- *Capacitacion en Fabricacion y Caracterizacion de Celdas Solares.* M.G. Martinez Bogado, M.J.L. Tamasi, C.G. Bolzi and J.C.Pla. In collaboration with the PUCRS, Brazil.

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List of abbreviations

ANU	Australian National University
ANPCyT	Agencia Nacional de Promoción Científica y Tecnológica
CAPES	Fundação Coordenação de Aperfeiçoamento de Pessoal de Nivel Superior
CBPF	Centro Brasileiro de Pesquisas Físicas
CENG	Centre d'Etudes Nucleaires Grenoble
CERN	European Laboratory for Particle Physics
CIC	Consejo de Investigaciones Científicas, Prov. de Buenos Aires
CITEFA	Centro de Investigaciones Científicas y Técnicas de las Fuerzas Armadas
CNPq	Centro Nacional de Pesquisas
CNR	Centro Nazionale della Ricerca
CNRS	Centre National de la Recherche Scientifique
CONAE	Comisión Nacional de Actividades Espaciales
CONICET	Consejo Nacional de Investigaciones Científicas y Tecnológicas
ICTP	International Centre for Theoretical Physics
IRAM	Instituto Argentino de Normalización
FCEyN	Facultad de Ciencias Exactas y Naturales
LAMEL	Istituto di Chimica e Tecnologia di Materiali e dei Componenti per l'Elettronica
PICT	Proyectos de Investigación en Ciencia y Tecnología
SeCyT	Secretaría de Ciencia y Tecnología
TRIL	Training and Research in Italian Labs
UBA	Universidad de Buenos Aires
UERJ	Univ. do Estado do Rio de Janeiro
UNSaM	Universidad Nacional de General San Martín